



**POINT LONELY SRRS
ALASKA**

**ADMINISTRATIVE RECORD
COVER SHEET**

AR File Number 460

Installation Restoration Program (IRP) Remedial Investigation/Feasibility Study

Stage 3

**Barter Island AFS (BAR-M), Alaska
Bullen Point AFS (POW-3), Alaska
Point Lonely AFS (POW-1), Alaska**

Prepared by

Woodward-Clyde Consultants

500 12th Street, Suite 100, Oakland, CA 94607-4014

August 1990

Final Report (July 1988 - August 1990)

Volume I: Text, Appendices A to D, F, G

Approved for Public Release; Distribution is Unlimited

Prepared for

Tactical Air Command Environmental Planning Division (HQ TAC/DEEV)

Langley Air Force Base, Virginia 23665-5542

United States Air Force Human Systems Division (AFSC) IRP Program Office (HSD/YAQ)

Brooks Air Force Base, Texas 78235-5501

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FINAL REPORT
VOLUME I: TEXT, APPENDICES A TO D, F AND G
FOR

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Bullen Point AFS (POW-3), Alaska
Point Lonely AFS (POW-1), Alaska

Tactical Air Command
Environmental Planning Division (HQ TAC/DEEV)
Langley AFB, Virginia 23665-5542

August 31, 1990

Prepared by

Woodward-Clyde Consultants
500 12th Street, Suite 100
Oakland, California 94607

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APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

IRP Program Office (HSD/YAQ)

Franz J. Schmidt, Capt., USAF, Project Manager

HUMAN SYSTEMS DIVISION
IRP PROGRAM OFFICE (HSD/YAQ)
BROOKS AIR FORCE BASE, TEXAS 78235-5501

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This technical report presents the Installation Restoration Program, Remedial Investigation/ Feasibility Study (Stage 3) for Barter Island AFS (BAR-M), Bullen Point AFS (POW-3), and Point Lonely AFS (POW-1), three of the Alaska DEW Line stations. Eighteen (18) sites were included in the Stage 3 field investigation program. At BAR-M, the seven sites included are: Old Landfill, Sewage Lagoon, POL Catchment Area, New Landfill, Contaminated Ditch, Old Dump Site N.W. and Old Airport Dump. At POW-3, the six sites included are: Shed No. 1, Shed No. 2, Outside Transformer, Inside Transformer, POL Tanks and Old Landfill. At POW-1, the five sites included are: Old Sewage Outfall/Beach Tanks, POL Storage Area, Large Fuel Spill, Old Landfill and Husky Landfill. The primary emphasis of the field investigations performed during the summer of 1988 was to conduct soil and surface water sampling programs for laboratory analysis of potential contaminants at the selected DEW Line station sites. In addition, (Continued)				
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engineering investigations (i.e., hydrologic evaluations, landfill erosion control studies, and POL tank inspections) were performed at sites prescribed in the Statement of Work, and simple removals were implemented.

The field investigation program results, followed by a qualitative risk screening process, indicate that only minor surface water quality degradation and soil contamination caused by station landfills and petroleum storage and handling facilities has occurred at all but one site, the Large Fuel Spill at POW-1. At that site relatively high levels of TPH contamination was observed, and a feasibility study (FS) was performed consisting of an evaluation of technologies which could be used for remedial actions. At BAR-M, a hydrologic evaluation of an approximate 50-acre study area adjacent to the Beaufort Sea and an engineering evaluation for erosion control indicated the desirability of Initial Remedial Measures (IRMs) to ameliorate or remedy several situations at the Old Landfill, New Landfill, and Sewage Lagoon. Recommendations for IRMs were made as appropriate. At POW-3 POL Tanks, seven tanks were inspected for signs of corrosion. An IRM was recommended to decommission the tanks in order to prevent future leakage. In the vicinity of the POW-1 Husky Landfill, a hydrology study was conducted to assess the sources and volume of waterflow through the landfill. An IRM was recommended to minimize water flow through the landfill, and thereby minimize leachate generation. In addition to the FS and IRMs, where existing data were sufficient to assess that site conditions have no significant impact on human health or the environment, Technical Documents to Support No Further Action (TDSNFAs) will be prepared for 17 sites at the three DEW Line stations, and a Technical Document to Support Remedial Action Alternatives (TDSRAA) will be prepared for the fuel spill area at POW-1.

PREFACE

This Technical Report describes the investigative and evaluative techniques and results adopted for the USAF under contract F33615-85-D-4544/0008 to conduct a Stage 3 IRP Remedial Investigation/Feasibility Study (RI/FS) for Barter Island AFS (BAR-M), Bullen Point AFS (POW-3), and Point Lonely AFS (POW-1), three of the Alaska DEW Line stations.

This assignment includes reviewing site history and defining the framework for this RI/FS; establishing the environmental setting through existing reports; conducting the field investigation program in conformance with the Stage 3 Final Work Plan; discussing results and significant findings; providing a qualitative risk screening of identified contaminated sites; identifying, screening, and analyzing remedial measures; and recommending which sites require no further IRP action, require additional IRP effort, or require recommended remedial actions. Field work took place in Summer 1988.

Captain Franz J. Schmidt, USAF Human Systems Division, IRP Program Office (HSD/YAQ), was the Technical Program Manager.

Approved:



James D. Sartor
Program Manager
Woodward-Clyde Consultants

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EXECUTIVE SUMMARY

INTRODUCTION

Woodward-Clyde Consultants (WCC) has been retained by the United States Air Force (USAF), under Contract Number F33615-85-D-4544/0008, to implement an Installation Restoration Program (IRP) Remedial Investigation/Feasibility Study (RI/FS), Stage 3, for three Distant Early Warning (DEW) Line stations. The DEW Line stations studied are located on the northern coast of Alaska adjacent to the Beaufort Sea and include Barter Island AFS (BAR-M), Bullen Point AFS (POW-3), and Point Lonely AFS (POW-1).

BARTER ISLAND AFS (BAR-M)

The number and type of samples taken are detailed in Table ES-1. The maximum BAR-M soil/sediment contaminant concentrations are listed in Table ES-2; the maximum BAR-M surface water/leachate contaminant concentrations are given in Table ES-3.

Old Landfill (Site 1). The BAR-M Old Landfill was investigated because erosion due to incised stream channels and coastal bluff erosion has exposed the fill contents and surface waters may carry contamination to the sea. One Old Landfill soil/sediment sample contained total petroleum hydrocarbons (TPHs) at a concentration of 96 mg/kg. The Old Landfill surface water/leachate results included TPHs concentrations of 0.7 and 0.8 mg/L. Leachate at the Old Landfill contained up to 2 MPN (most probable number)/100 ml total coliform. The risk screening conclusion is that risk is not classified as significant at this site. The Old Landfill is recommended to be classified a Category 1 site because no further IRP studies are required. Nevertheless, an Initial Remedial Measure (IRM) is

Table ES-1. NUMBER OF SAMPLES TAKEN

	Soil	Aqueous	Waste
<u>BARTER ISLAND (BAR-M)</u>			
<u>Old Landfill</u>			
OL-1	1	1	--
OL-2	1	1	--
OL-3	--	1	--
OL-4	1	1	--
OL-5	1	1	--
<u>Sewage Lagoon</u>			
SL-1	--	1	--
SL-2	--	1	--
SL-3	1	1	--
<u>POL Catchment</u>			
PB-1	1	1	--
PB-2	2	1	--
PB-3	1	1	--
PB-4	1	--	--
PB-5	1	--	--
PB-6	1	--	--
PB-7	1	--	--
<u>New Landfill</u>			
NL-1	1	1	--
NL-2	1	1	--
NL-3	1	1	--
NL-4	1	1	--
<u>Contaminated Ditch</u>			
CD-1	1	1	--
CD-2	1	2	--
CD-3	1	1	--
CD-4	--	1	--

Table ES-1. NUMBER OF SAMPLES TAKEN (continued)

	Soil	Aqueous	Waste
<u>BULLEN POINT (POW-3)</u>			
<u>Inside Transformer</u>			
IT-1	--	--	1
IT-2	1	--	--
IT-3	1	--	--
<u>Old Landfill</u>			
OL-1	1	1	--
OL-2	1	--	--
OL-3	1	2	--
OL-4	2	--	--
<u>POINT LONELY (POW-1)</u>			
<u>Old Sewage Outfall</u>			
SO-1	1	1	--
SO-2	1	--	--
SO-3	1	--	--
<u>POL Storage Area</u>			
PS-1	1	--	--
PS-2	1	--	--
PS-3	2	--	--
PS-4	1	--	--
PS-5	1	--	--
PS-6	--	1	--
PS-7	1	--	--
PS-8	1	--	--
<u>Large Fuel Spill</u>			
FS-1	1	--	--
FS-2	1	--	--
FS-3	1	--	--
FS-4	1	--	--
FS-5	1	1	--
FS-6	1	1	--
FS-7	1	1	--
<u>Old Landfill</u>			
OL-1	1	--	--
OL-2	1	--	--

Table ES-1. NUMBER OF SAMPLES TAKEN (concluded)

	Soil	Aqueous	Waste
<u>Husky Landfill</u>			
HL-1	--	1	--
HL-2	1	--	--
HL-3	--	1	--
HL-4	2	--	--
HL-5	--	1	--
HL-6	1	--	--
HL-7	--	1	--
HL-8	1	--	--
HL-9	--	2	--
HL-10	1	--	--

Table ES-2. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS DETECTED IN SOIL/SEDIMENT AT BARTER ISLAND AFS (BAR-M) SITES

Parameter	Old Landfill (Site 1)				Sewage Lagoon (Site 2)	POL Catchment Area (Site 3)							New Landfill (Site 4)				Contaminated Ditch (Site 8)		
	OL-1	OL-2	OL-4	OL-5	SL-3	PB-1	PB-2	PB-3	PB-4	PB-5	PB-6	PB-7	NL-1	NL-2	NL-3	NL-4	CD-1	CD-2	CD-3
<u>Organics (mg/kg)</u>																			
Total Petrol. Hydroc.	96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Other Analytes*	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	ND	ND

ND = Not detected

-- = Not tested

* See Appendix E, Table E-2

Table ES-3. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS DETECTED IN SURFACE WATER/LEACHATE AT BARTER ISLAND AFS (BAR-M) SITES

Parameter	Old Landfill (Site 1)					Sewage Lagoon (Site 2)			POL Catchment Area (Site 3)			New Landfill (Site 4)				Contaminated Ditch (Site 8)			
	OL-1	OL-2	OL-3	OL-4	OL-5	SL-1	SL-2	SL-3	PB-1	PB-2	PB-3	NL-1	NL-2	NL-3	NL-4	CD-1	CD-2	CD-3	CD-4
<u>Organics (ug/L)</u>																			
1,1-Dichloroethane	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	3.9	ND	ND	ND	--
Trichloroethene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	18	ND	ND	ND	--
Benzene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	14	40	ND	ND	ND	--
Toluene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	23	34	ND	ND	ND	--
Ethyl benzene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	7.2	ND	ND	ND	--
m-Xylene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	12	ND	ND	ND	--
o & p-Xylene(s)	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	8	ND	ND	ND	--
Other Analytes*	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	ND	ND	--
<u>Total Petrol.</u>																			
Hydroc. (mg/L)	.8	ND	ND	.7	ND	ND	ND	ND	ND	ND	.5	.7	ND	ND	3	ND	.7	ND	1
<u>Wastewater (mpn/100 ml)</u>																			
Total Coliform	--	ND	--	2	--	1100	4000	--	--	--	--	--	--	--	--	ND	ND	ND	--

ND = Not detected

-- = Not tested

* See Appendix E, Table E-3

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recommended to control potential environmental effects due to coastal erosion by removal of the Old Landfill back from the bluff with the utilization of local labor.

Sewage Lagoon (Site 2). The Sewage Lagoon was investigated because of its potential hydrologic impact on the other BAR-M sites; the coliform analyses were added as the request of the Alaska Department of Environmental Conservation (ADEC). The Sewage Lagoon wastewater contained from 1100 to 4000 MPN/100 ml total coliform. Consequently, the water in the lagoon may contain pathogenic microorganisms for which total coliform counts are indicators. Risk is classified as not significant at the Sewage Lagoon. The Sewage Lagoon is recommended to be classified a Category 1 site. An IRM is recommended to install an inverted filter around the pipe in the northwest corner of the gravel berm. This repair is recommended because the overall integrity of the lagoon berm may be compromised by continued leakage.

POL Catchment Area (Site 3). The POL Catchment area was investigated because spills have been reported in the petroleum, oils, and lubricants (POL) tanks vicinity. At the POL Catchment Area, TPHs were reported in one of three surface water/leachate samples at the detection limit of 0.5 mg/L. Risk is classified as not significant at the POL Catchment Area. The BAR-M POL Catchment Area is recommended to be classified a Category 1 site.

New Landfill (Site 4). The BAR-M New Landfill was investigated because disposal of materials from the village of Kaktovik is uncontrolled, and the nature and concentration of material is not fully characterized. In the New Landfill surface water/leachate samples, 1,1-dichloroethane concentrations ranged from not detected (ND) to 3.9 $\mu\text{g/L}$, trichloroethene from ND to 18 $\mu\text{g/L}$, benzene from ND to 40 $\mu\text{g/L}$, toluene from ND to 34 $\mu\text{g/L}$, ethyl benzene from ND to 7.2 $\mu\text{g/L}$, m-xylenes from ND to 12 $\mu\text{g/L}$, o- and p-xylenes from ND to 8 $\mu\text{g/L}$, and TPHs from ND to 3.0 mg/L. Risk is classified as not significant at the New Landfill, and the New Landfill is recommended to be classified a Category 1 site. An IRM to reduce leachate generation, without damaging the native tundra, is recommended; it consists

of capping the inactive portion of the landfill with locally available sand and gravel mixed with imported bentonite.

Contaminated Ditch (Site 8). The BAR-M Contaminated Ditch was investigated because it may have been used historically as a waste disposal area. In the Contaminated Ditch surface water/leachate samples, TPHs were reported in concentrations from ND to 1.0 mg/L. Risk is classified as not significant at the Contaminated Ditch. The Contaminated Ditch is recommended to be classified a Category 1 site.

Old Dump Site N.W. (Site 9) and Old Airport Dump (Site 12). Soil and water samples were not collected at these sites for analytical laboratory tests. Based on information obtained in earlier IRP investigations, both sites are recommended to be classified Category 1 sites.

BULLEN POINT AFS (POW-3)

The maximum soil/sediment contaminant concentrations identified at POW-3 are listed in Table ES-4; no surface water/leachate samples were taken at POW-3.

Shed No. 1 (Site 1), Shed No. 2 (Site 2), POL Tanks (Site 5), and Generator Room. The purpose of the simple removals program at these POW-3 locations was to remove suspected hazardous materials that may have represented an immediate threat to human health or the environment. The simple removals scope included identification, testing, overpacking, and shipment off site of suspected hazardous materials.

A tank inspection was carried out on the seven POL Tanks (Site 5) because the tanks are badly deteriorated. Removal of remaining tank bottom material, estimated to be 4-6 inches deep, from the tanks to minimize possible future leakage is proposed as an IRM.

Soil and water samples were not collected at these sites for analytical laboratory tests. All sites are recommended to be classified Category 1 sites because no additional IRP investigations are required.

Table ES-4. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS
DETECTED IN SOIL/SEDIMENT AT BULLEN POINT AFS (POW-3) SITES*

Parameter	Inside Transformer (Site 4)			Old Landfill (Site 6)			
	IT-1**	IT-2	IT-3	OL-1	OL-2	OL-3	OL-4
<u>Organics (mg/kg)</u>							
Aroclor 1254	ND	3.9	5.9	--	--	--	--
Total Petroleum Hydrocarbons	--	--	--	ND	138	ND	ND
Other Analytes***	ND	ND	ND	ND	ND	ND	ND

ND = Not detected

-- = Not tested

* Soil samples were not collected for analytical laboratory testing at the following sites: Shed No. 1 (Site 1), Shed No. 2 (Site 2), Outside Transformer (Site 3), and POL Tanks (Site 5).

** Waste Sample

*** See Appendix E, Table E-5

Outside Transformer (Site 3). The POW-3 Outside Transformer was investigated to determine if it contained polychlorinated biphenyls (PCBs). Soil and water samples were not collected at this site for analytical laboratory tests. Hazardous materials were not removed from this transformer because it was found to be nitrogen-filled. The Outside Transformer site is recommended to be classified a Category 1 Site.

Inside Transformer (Site 4). The POW-3 Inside Transformer was investigated to determine if it contained PCBs. Aroclor 1254 was detected from 3.9 to 5.9 mg/kg in soil/sediment samples taken at the Inside Transformer. These samples were collected from beneath the Module Train. Transformer oil was reported as ND with the detection limit of 0.01 mg/kg for Aroclor 1254. The transformer and oil-soaked floor tiles were removed from the site during the simple removals program. Risk is classified as not significant at the POW-3 Inside Transformer. The Inside Transformer site is recommended to be classified a Category 1 site.

Old Landfill (Site 6). The POW-3 Old Landfill was investigated to characterize its contents and determine if hazardous materials are contaminating the environment. At the Old Landfill, TPHs were reported in concentrations from ND to 138 mg/kg in soil/sediment samples. Risk is classified as not significant at the POW-3 Old Landfill. The Old Landfill site is recommended to be classified a Category 1 site.

POINT LONELY AFS (POW-1)

The maximum soil/sediment contaminant concentrations at POW-1 are listed in Table ES-5; the maximum surface water/leachate contaminant concentrations are given in Table ES-6.

Old Sewage Outfall and Beach Tanks (Sites 25/27). The POW-1 Old Sewage Outfall and Beach Tanks were investigated to determine if tank spillage or leakage has occurred. At the Old Sewage Outfall, soil/sediment sample results included total xylenes concentrations ranging from ND to 14 mg/kg

Table ES-5. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS DETECTED IN SOIL/SEDIMENT AT POINT LONELY AFS (POW-1) SITES

Parameter	Old Sewage Outfall (Site 25/27)			POL Storage Area (Site 28)							Large Fuel Spill (Sites 29/29A)							Old Landfill (Site 31)		Husky Landfill (Site 32)					
	SO-1	SO-2	SO-3	PS-1	PS-2	PS-3	PS-4	PS-5	PS-7	PS-8	FS-1	FS-2	FS-3	FS-4	FS-5	FS-6	FS-7	OL-1	OL-2	HL-2	HL-4	HL-6	HL-8	HL-10	
<u>Organics (mg/kg)</u>																									
Toluene	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	0.1	0.32	ND	ND	
Total Xylenes	14	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	0.28	0.66	ND	ND	
Total Petrol, Hydroc.	1300	72	ND	290	40	140	5400	1000	ND	ND	25000	830	ND	840	ND	ND	ND	ND	77	1900	43	200	1600	62	
Other Analytes*	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	ND	ND	

ND = Not detected

-- = Not tested

* See Appendix E, Table E-8

Table ES-6. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS DETECTED IN SURFACE WATER/LEACHATE AT POINT LONELY AFS (POW-1) SITES*

Parameter	Old Sewage Outfall (Site 25/27)	POL Storage Area (Site 28)	Large Fuel Spill (Sites 29/29A)			Husky Landfill (Site 32)				
	SO-1	PS-6	FS-5	FS-6	FS-7	HL-1	HL-3	HL-5	HL-7	HL-9
<u>Organics (µg/L)</u>										
1,1-Dichloroethane	ND	--	--	--	--	ND	ND	3.6	ND	ND
1,1,1-Trichloroethane	ND	--	--	--	--	ND	ND	10	ND	ND
Trichloroethene	ND	--	--	--	--	2.6	11	ND	ND	ND
Benzene	190	--	--	--	--	2.7	130	93	ND	ND
Toluene	380	--	--	--	--	3.2	240	270	ND	ND
Ethyl benzene	57	--	--	--	--	ND	32	32	ND	ND
m-Xylene	1600	--	--	--	--	2.0	96	84	ND	ND
o & p-Xylene(s)	350	--	--	--	--	3.4	120	97	ND	ND
Other Analytes**	ND	--	--	--	--	ND	ND	ND	ND	ND
<u>Total Petrol. Hydroc. (mg/L)</u>	6	2	3	1	1	.5	2	.5	2	1

ND = Not detected

-- = Not tested

* Water samples were not collected for analytical laboratory testing at the Old Landfill (Site 31).

** See Appendix E, Table E-9

and TPHs concentrations ranging from ND to 1300 mg/kg. Surface water/leachate sample results included benzene concentrations at 190 µg/L, toluene at 380 µg/L, ethyl benzene at 57 µg/L, m-xylene at 1600 µg/L, o- and p-xylenes at 350 µg/L, and TPHs at 6 mg/L. Risk is classified as not significant at the Old Sewage Outfall and Beach Tanks. The Old Sewage Outfall and Beach Tanks are recommended to be classified as a Category 1 site because no further IRP investigations are required. If remediation at the POW-1 Large Fuel Spill can be achieved to reduce TPHs concentrations in soil to below 5000 mg/kg, soil remediation will be attempted at this site.

POL Storage Area (Site 28). The POL Storage Area was investigated because the ponded water was reported contaminated with petroleum hydrocarbons. At the POL Storage Area, TPHs concentrations in soil/sediment ranged from ND to 5400 mg/kg and TPHs concentration in surface water/leachate was detected at 2.0 mg/L. Risk is classified as not significant at the POL Storage Area. The POL Storage Area is recommended to be classified as a Category 1 site. If remediation at the POW-1 Large Fuel Spill can be achieved to reduce TPHs concentrations in soil below 5000 mg/kg, soil remediation will be attempted at this site.

Large Fuel Spill (Sites 29/29A). The Large Fuel Spill (Sites 29/29A) area contamination was investigated because a 1978 fuel line break spilled approximately 25,000 gallons of diesel fuel onto the ground (CH2M Hill 1981). At the Large Fuel Spill, TPHs concentrations in soil/sediment samples ranged from ND to 25,000 mg/kg and in surface water/leachate samples from 1.0 to 3.0 mg/L.

Risk associated with the contaminants at this site was classified as insignificant. Although this conclusion suggests that no further action is necessary to protect human health based on the qualitative risk screening, the concentration of TPHs exceeds Alaska's interim cleanup standard for TPHs in soil. The California Leaking Underground Fuel Tanks Manual was utilized in this investigation to evaluate the impact of the POW-1 Large Fuel Spill and to set a cleanup level. The cleanup level for diesel fuel recommended by the California LUFT guidance when the distance to

groundwater is greater than 100 feet and certain other conditions are met is 10,000 mg/kg. Cleanup below this level will be attempted in an effort to achieve Alaska's interim cleanup standard of 100 mg/Kg in soil.

The Large Fuel Spill Feasibility Study (FS) recommends bioremediation of the affected areas. For part of the area covered by a fill pad, this remediation is to be done by excavation and on-site land farming of the contaminated soil. For part of the area that is reasonably undisturbed tundra, the recommended remediation is in situ enhanced bioremediation.

The POW-1 Large Fuel Spill is recommended to be classified as a Category 3 site because the FS process has been completed and remediation is recommended.

Old Landfill (Site 31). The Old Landfill was investigated because the lagoon side of the landfill is eroding and some of the fill was exposed. At the Old Landfill, TPHs concentrations in soil/sediment samples ranged from ND to 77 mg/kg. No other organic contaminants were detected. Risk is classified as not significant at the POW-1 Old Landfill. The Old Landfill is recommended to be classified as a Category 1 site.

Husky Landfill (Site 32). The Husky Landfill was investigated because it reportedly received a variety of wastes including waste oils and solvents during the years of operation ending in 1986. The following organic contaminants were detected in soil/sediment samples: toluene from ND to 0.32 mg/kg, total xylenes from ND to 0.66 mg/kg, and TPHs from ND to 1900 mg/kg. Organic contaminants detected in surface water/leachate samples included 1,1-dichloroethane from ND to 3.6 µg/L, 1,1,1-trichloroethane from ND to 10 µg/L, trichloroethene from ND to 11 µg/L, benzene from ND to 130 µg/L, toluene from ND to 270 µg/L, ethyl benzene from ND to 32 µg/L, m-xylenes from ND to 96 µg/L, o- and p-xylenes from ND to 120 µg/L, and TPHs from 0.5 mg/L to 2.0 mg/L. Risk is classified as not significant at the POW-1 Husky Landfill. The Husky Landfill is recommended to be classified as a Category 1 site.

WCC recommends an IRM to minimize the water flow through the Husky Landfill. A remedial action is needed for each of three water inflow sources: infiltration from the Husky Camp gravel and pad surface, infiltration from ponds east of the landfill, and percolation of rain and snowmelt. To control inflow from direct precipitation, sources creating snowpack accumulation should be moved, and the permeable gravel cover over the fill should be capped with less permeable materials and graded to promote drainage away from the landfill. Flow from the east side ponds should be minimized by improving surface drainage. Infiltration from the main pad that flows through the landfill should be eliminated by the construction of a cutoff wall on the east side of the landfill. An innovative method to minimize leachate flow would be to draw the permafrost surface up into the landfill by the addition of cover material over the landfill.

Table ES-7 summarizes the IRP recommendations for the BAR-M, POW-3 and POW-1 sites investigated in this RI/FS study.

Table ES-7. SUMMARY OF RECOMMENDATIONS

BAR-M

Old Landfill (Site 1) -	No further IRP investigations, Category 1; IRM to move Old Landfill back from bluff.
Sewage Lagoon (Site 2) -	No further IRP investigations, Category 1; IRM to control erosion due to leakage.
POL Catchment Area (Site 3) -	No further IRP investigations, Category 1.
New Landfill (Site 4) -	No further IRP investigations, Category 1; IRM to cap the inactive portion of landfill.
Contaminated Ditch (Site 8) -	No further IRP investigations, Category 1.
Old Dump Site N.W. (Site 9) and Old Airport Dump (Site 12) -	No Further IRP investigations, Category 1.

POW-3

Shed 1 (Site 1) -	No further IRP investigations, Category 1.
Shed 2 (Site 2) -	No further IRP investigations, Category 1.
POL Tanks (Site 5) -	No further IRP investigations, Category 1; empty POL tanks as suggested IRM.
Generator Room (No Site No.) -	No further IRP investigations, Category 1.
Old Landfill (Site 6)	No further IRP investigations, Category 1.

POW-1

Old Sewage Outfall and Beach Tanks (Sites 25/27) -	No further IRP investigations, Category 1; remediation will be attempted.
POL Storage Area (Site 28) -	No further IRP investigations, Category 1; remediation will be attempted.
Large Fuel Spill (Sites 29/29A) -	FS process completed, remediation is recommended, Category 3 site.
Old Landfill (Site 31) -	No further IRP investigations, Category 1.
Husky Landfill (Site 32) -	No further IRP investigations, Category 1; IRM recommended to minimize water flow through the landfill.

1.0

INTRODUCTION

1.1 AIR FORCE INSTALLATION RESTORATION PROGRAM

The Department of Defense (DOD), due to its primary mission of defense of the United States, has been responsible for a wide variety of operations that generated toxic and hazardous substances. These hazardous substances, if released into the environment, could potentially affect human health and the environment. The DOD recognizes this potential threat and has taken action to address not only current and future hazardous waste operations, but the risk posed by hazardous substances at past waste disposal sites. The DOD program to identify, investigate, and clean up past disposal sites is called the Defense Environmental Restoration Program (DERP). The United States Air Force (USAF) is implementing the DERP through its Installation Restoration Program (IRP) to address the problems of hazardous waste at USAF installations.

Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of past disposal sites and take action to eliminate hazards in an environmentally responsible manner. To assure compliance with these hazardous waste regulations, the DOD developed the DERP. The current DOD DERP policy is specified in Defense Environmental Quality Program Policy Memorandum 81-5, dated December 11, 1981 and implemented by USAF message dated January 21, 1982. Memorandum 81-5 reissued and amplified all previous directives and memoranda on the IRP. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous waste contamination, and to implement remedial actions which will minimize hazards to health and

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welfare that resulted from these past operations.

The IRP is the basis for response actions on USAF installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as clarified by Executive Order 12316 and amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. These Federal Acts are the primary legislation governing remedial action at past hazardous waste disposal and spill sites. In most cases, the cutoff date distinguishing past or current operations is December 11, 1980, the CERCLA enactment date.

The eligibility cutoff date for Defense Environmental Restoration Account funding is March 1, 1984. Spills or waste disposal must have occurred before then to be eligible for IRP site status and funding.

The IRP has been modified to parallel the U.S. Environmental Protection Agency (EPA) Superfund Remedial Investigation/Feasibility Study (RI/FS) Program. The IRP was developed to provide response actions on USAF installations under provisions of CERCLA. The USAF Occupational and Environmental Health Laboratory Technical Services Division (USAFOEHL/TS) published the "Handbook to Support the Installation Restoration Program (IRP) Statements of Work for Remedial Investigation/Feasibility Studies (RI/FS)," Version 2.0, April 1988. The Handbook was developed as guidance to contractors in performing RI/FS investigations at USAF installations. The Handbook is designed to be responsive to SARA and includes language that is appropriate for studies meeting National Contingency Plan (NCP) criteria.

1.2 PURPOSE OF THIS REPORT

Woodward-Clyde Consultants (WCC) has been retained by the USAF under Contract Number F33615-85-D-4544/0008 to initiate IRP Remedial Investigation/Feasibility Studies (RI/FS), Stage 3 for three Distant Early

Warning (DEW) Line stations including Barter Island AFS (BAR-M), Bullen Point AFS (POW-3), and Point Lonely AFS (POW-1). This assignment included conducting a site investigation for observing any evidence of contamination, determining the hydrogeologic setting at the sites, and gathering information pertinent to the feasibility of various remedial alternatives. The purpose of this report is to summarize data collected from this field effort and to utilize these data, and data collected during previous IRP investigations, to identify and recommend remedial alternatives for those sites which pose a threat to human health and the environment (Appendix B).

1.3 PREVIOUS IRP ACTIVITIES

The previous IRP activities were undertaken in a sequential phased program. The previous work for the three DEW Line stations considered in this IRP report, by CH2M Hill and Dames & Moore, under contract with the USAF, is briefly described below and presented in detail in Sections 2.9, 2.11 and 2.13 for BAR-M, POW-3 and POW-1, respectively.

1.3.1 Phase I - Problem Identification/Records Search

CH2M Hill performed IRP Phase I Problem Identification/Records Search in Summer 1981. The field team identified past waste disposal and spill sites. This phase constituted a preliminary assessment of the hazards at each installation. Sites were identified from a review of base records, interviews with current and former base employees, and aerial and ground reconnaissance. Hazards and potential hazards were assessed based on material disposed and a review of regional geological and hydrogeological factors. This phase did not include sampling and analysis. The Phase I Problem Identification/Records Search Report identified and ranked DEW Line Air Force station hazardous waste sites and determined the potential for migration of hazardous or toxic wastes resulting from past operation and disposal activities at the sites. Utilizing a modified standard site rating assessment format, Hazardous Assessment Rating Methodology (HARM),

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to rank the waste sites at each DEW Line station, CH2M Hill determined which sites at each station required further investigation (CH2M Hill 1981). The results of this site rating assessment are presented in Section 2.9.1 for BAR-M, 2.11.1 for POW-3, and 2.13.1 for POW-1.

1.3.2 Phase II - Confirmation/Quantification (Stage 1)

Dames & Moore performed Phase II - Confirmation/Quantification (Stage 1) activities in Summer 1984. In this phase, initial field and laboratory data were collected and analyzed to assess the nature and extent of the contamination at sites identified in Phase I by CH2M Hill. Sites requiring remedial action were identified and programmed for further work. The results of the Phase II, Stage 1 investigation are presented in Section 2.9.2 for BAR-M, 2.11.2 for POW-3, and 2.13.2 for POW-1.

1.3.3 Phase II - Confirmation/Quantification (Stage 2)

Dames & Moore performed Phase II - Confirmation/Quantification (Stage 2) work in Summer 1986. In this stage, additional field and laboratory data were collected and analyzed to assess the nature and extent of the contamination at sites previously investigated in Phase II, Stage 1. The results of the Phase II, Stage 2 investigation are discussed in Section 2.9.3 for BAR-M, 2.11.3 for POW-1, and 2.13.3 for POW-3.

1.4 DISTANT EARLY WARNING (DEW) LINE SYSTEM

In 1952, the United States and Canadian government officials realized that there was a need to protect their countries from destructive airborne attacks by potential enemies. The military community formed a scientific team (code name "Summer Study Group") to research and solve the critical problem. The USAF accepted the scientists' recommendation to invent, install, and maintain a distant early warning radar and communication system; and position it as close as possible to the threatening enemy air bases (Morenus 1957).

The DEW Line System was designed to detect and report all airborne vehicles operating within the designated detection capabilities of the surveillance radars. The Alaska segment of the DEW Line System went into full operation in 1953. After successful operation in Alaska, the remainder of the line extending across Canada and Greenland was constructed (Morenus 1957).

The Bell System Western Electric Company was the primary contractor, with responsibility for engineering, construction, installation, and initial operation of the DEW Line System on Alaska's north coast. The design and construction of the Alaska segment was a first-time event for almost every phase of the project. Radar and radio equipment, with its associated electronic components, were invented to survive an environment of -60°F in winter, electronic storms in summer, fluctuating currents of the North Magnetic Pole, and the strange phenomenon of northern lights. Fortunately, many of the construction logistics and survival problems had been met and solved by the U.S. Navy at its World War II base located in Point Barrow, Alaska (Morenus 1957).

The Alaska DEW Line System is a USAF contractor-operated radar/communications network that is a part of the overall Tactical Air Command/North American Air Defense Command (TAC/NORAD) air defense mission. Since 1957, the System has been operated by a civilian contractor. Today, ITT/FELEC Services, Inc. operates the installations under the supervision of TAC personnel.

The DEW Line System is divided into six sectors for military, functional, and operational purposes. However, the contractor has been permitted to restructure the DEW Line into four civilian geographical sections for administrative and logistic purposes. Civil engineering management is provided on the Alaska DEW Line segment from the 4700 OSS/DE, Langley AFB, Virginia.

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The DEW system contractor is responsible for maintenance management of real property facilities, which include the buildings, roads, grounds, aircraft facilities, antenna structures, utility plants; and for operation of systems for supply, generation, or disposition of electricity, water, sewage, and refuse. These responsibilities are carried out at each station through the station supervisor and the area manager for the Alaska DEW Line stations.

1.5 BARTER ISLAND AFS (BAR-M)

BAR-M is located on the northern coast of Alaska near the Canadian border (Figures 1-1 and 1-2). It is the easternmost of the Alaska DEW Line stations and occupies 4353 acres. At most 75 personnel can be stationed at BAR-M. The village of Kaktovik (population approximately 250) is located about $\frac{1}{2}$ mile southeast of the installation. BAR-M went into operation in 1953 and was turned over to a civilian contractor for operation and maintenance in 1957.

1.5.1 Past Waste Management Practices

Various methods of waste management have been used at BAR-M. In the past, wastes were disposed in landfills and dumped on the sea ice. Wastes are currently landfilled at the installation in compliance with USAF requirements. The installation landfill is also used by the nearby village of Kaktovik, and this use is not controlled. Sewage from the installation and the Kaktovik 55-gallon sewage waste drums ("honey buckets") are disposed in a surface impoundment. Additional hazardous wastes at BAR-M are due to spills or leaks of petroleum products.

1.5.2 Site Descriptions

At BAR-M, WCC performed a field reconnaissance in Summer 1987 and commenced an IRP Stage 3 field investigation in Summer 1988. Five sites were identified at the BAR-M installation: the Old Landfill (Site 1), the Sewage Lagoon (Site 2), the POL Catchment Area (Site 3), the New Landfill

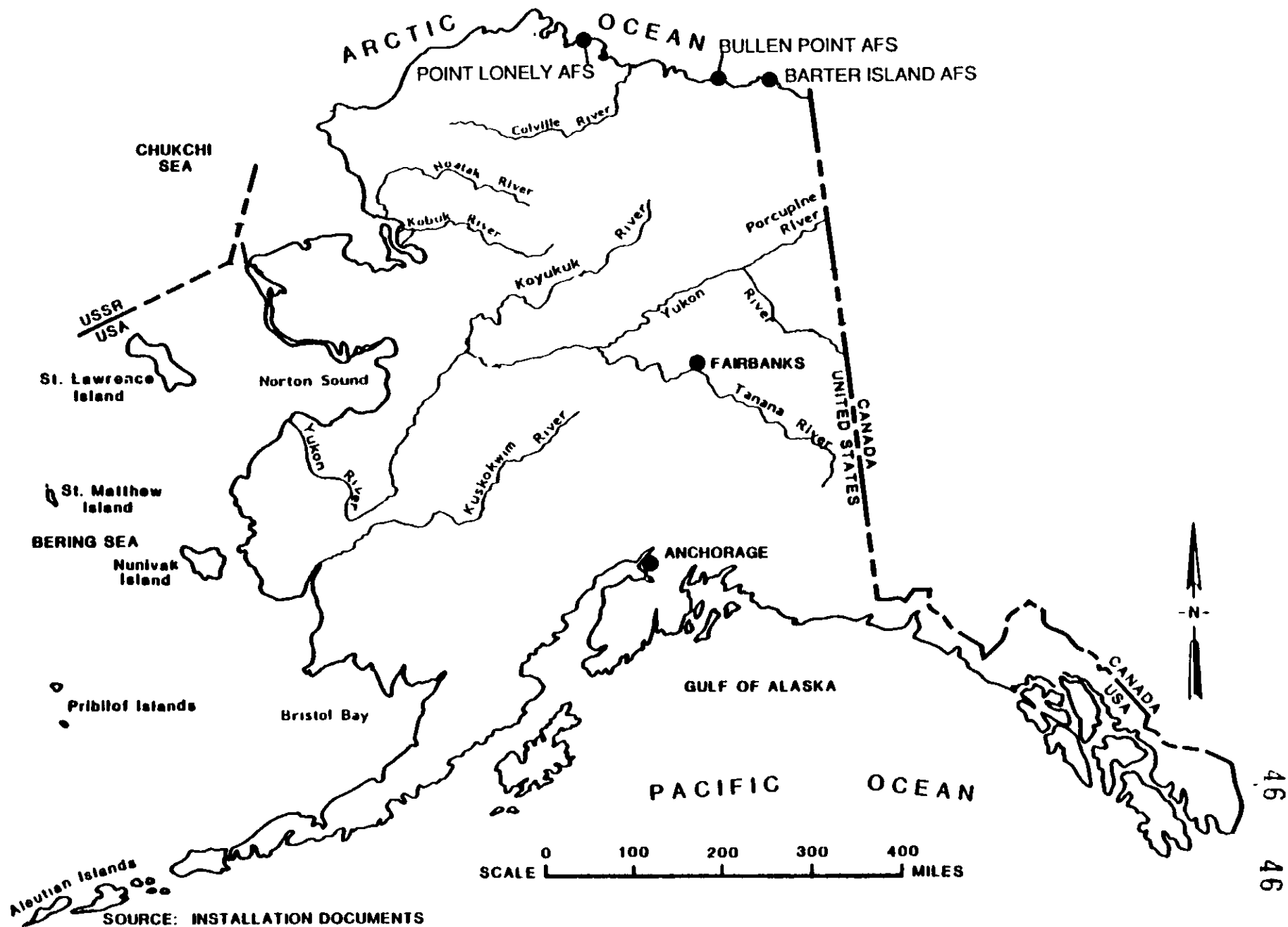


Figure 1-1. REGIONAL LOCATION

(Site 4), and the Contaminated Ditch (Site 8). Two additional sites--the Old Dump Site N.W. (Site 9) and the Old Airport Dump (Site 12)--were identified as requiring no further action. These two sites will be addressed in a Technical Document to Support No Further Action (TDSNFA).

Description of the field investigation, and identification and characterization of the site contaminants are presented in Section 3.2. The five sites identified for additional field investigations at BAR-M are shown on Figure 1-3 and described below.

1.5.2.1 Old Landfill (Site 1). The Old Landfill is located at the northernmost boundary of BAR-M, adjacent to the Beaufort Sea. This landfill, approximately 2 to 3 acres, was used for all facility wastes from 1956 to 1978. The types and concentrations of materials buried in the landfill are unknown. Portions of the Old Landfill were recompacted, graded, and covered with soil in 1979. Erosion due to incised stream channels and coastal bluff erosion has exposed the fill contents in several locations. Surface water running across the site may carry contamination to the sea.

1.5.2.2 Sewage Lagoon (Site 2). The Sewage Lagoon is located north of the Module Trains and west of the access road. The Sewage Lagoon is approximately 225 feet by 500 feet and approximately 6 to 8 feet deep. This lagoon receives the sewage from the BAR-M package sewage treatment plant. In addition to the treated effluent from the station, the lagoon receives untreated waste from the village of Kaktovik. The village waste is stored in "honey buckets" and dumped annually into the lagoon.

1.5.2.3 POL Catchment Area (Site 3). The petroleum oils and lubricants (POL) catchment area is a small diked depression to the east of the POL storage tanks and north of the Module Trains. It serves as a catchment basin for spillage from the tanks. This area is not used for waste disposal, but spills that have occurred in the POL tank vicinity have

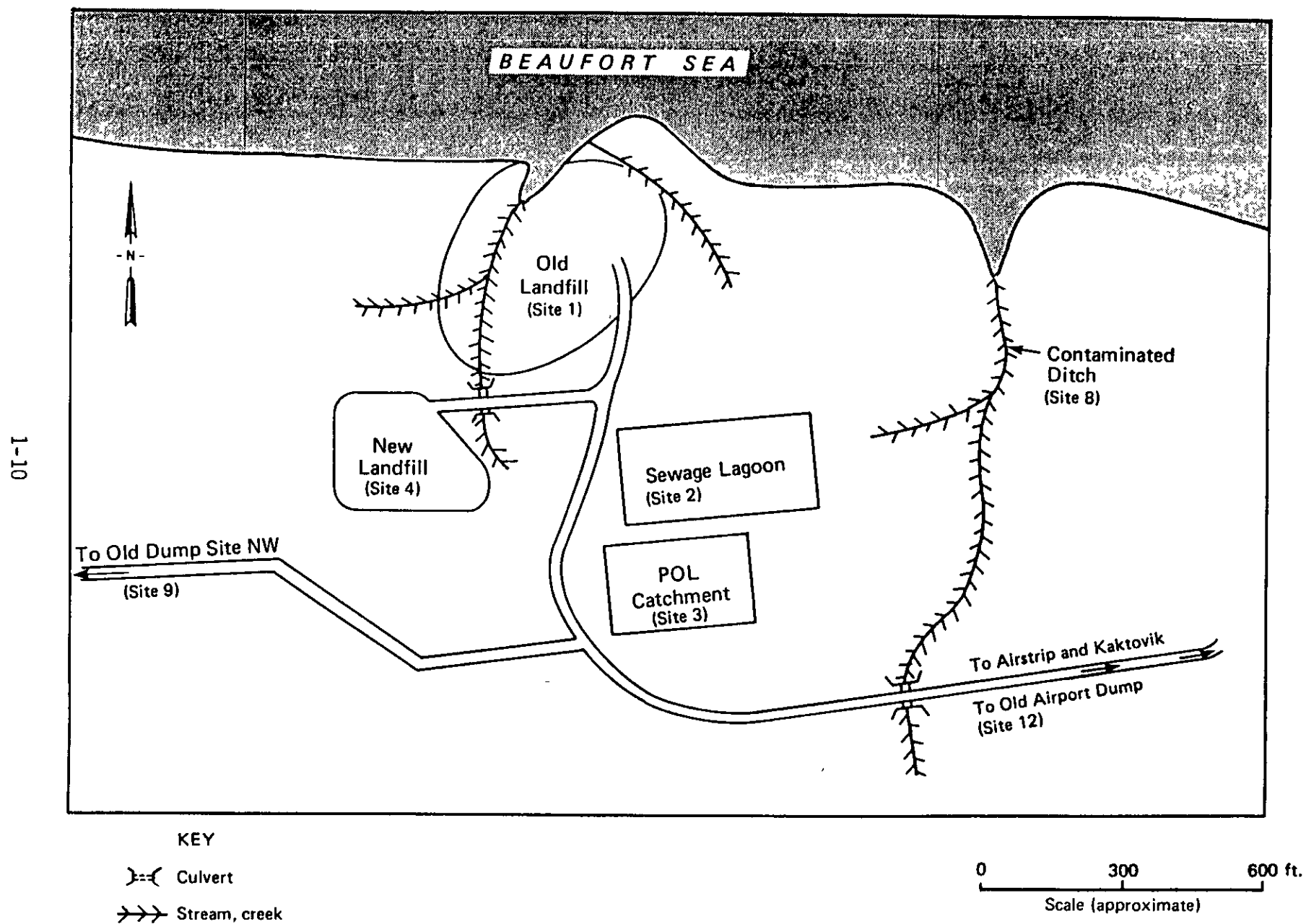


Figure 1-3. BARTER ISLAND AFS SITE LOCATIONS

collected in this area. The pond is approximately 20 feet in diameter and 2 to 3 feet deep. This pond was reported to be saturated with diesel fuel and waste oil products. CH2M Hill stated that this pond appeared to be a disposal site for diesel fuel and waste oil products (CH2M Hill 1981). Dames & Moore concluded that in the past water had flowed through a breach in the dike onto the tundra (Dames & Moore 1986).

1.5.2.4 New Landfill (Site 4). The New Landfill is located north of the Module Trains, southwest of the Old Landfill and west of the Access Road. It is approximately 2 acres in area and up to 6 feet in height. The New Landfill is separated from the Old Landfill and the Sewage Lagoon by a deep swale and an access road. Prior to the construction of the New Landfill, surface water generally flowed from the south to the north without channelized flow. This landfill is presently used for facility waste and for waste from the nearby village of Kaktovik. Beginning in June 1978, facility use of this site was expected to be in compliance with USAF requirements. However, the disposal of materials from Kaktovik is uncontrolled, and therefore, the nature and concentration of material at the New Landfill are not fully characterized.

1.5.2.5 Contaminated Ditch (Site 8). The Contaminated Ditch is a large, deep, eroding, natural gully, originating just west of the Module Trains, running to the north and discharging to the Beaufort Sea. This ditch may have been used historically as a waste disposal area, and a historic spill of antifreeze (ethylene glycol) was reported (CH2M Hill 1981). The Contaminated Ditch is intercepted by a smaller ditch that flows in an easterly direction from the Sewage Lagoon drainage area.

1.5.2.6 Old Dump Site N.W. (Site 9). The Old Dump Site N.W. was located approximately 1.7 miles west of the New Landfill. This site is thought to have been used for crushed drums and steel debris disposal. The site was less than an acre in size and reportedly cleaned up in 1979. The cleanup removed approximately 15 tons of scrap metal. No further detailed

information on the cleanup activities is available from the IRP reports (CH2M Hill 1981). This site was not located during the WCC 1987 field reconnaissance.

1.5.2.7 Old Airport Dump (Site 12). Located at the eastern end of the facility airstrip (3/4 mile east of the Module Trains), the Old Airport Dump was approximately 2 acres in size. This dump was used from approximately 1953 to 1956, and is thought to have received construction debris, vehicles, drums, and other facility wastes. This site was reportedly cleaned up in 1979-1980 (CH2M Hill 1981).

1.6 BULLEN POINT AFS (POW-3)

POW-3 is located on the northern coast of Alaska (Figures 1-1 and 1-4). This Alaska DEW Line station occupies 620 acres. There are no villages near the installation. POW-3 went into operation in 1953 and was turned over to a civilian contractor for operation and maintenance in 1957. The station was abandoned in 1971 but is still retained by the USAF.

1.6.1 Past Waste Management Practices

Various methods of waste management have been used at POW-3. In the past, wastes were disposed in a landfill near the lagoon east of the Module Trains. Wastes were left in or near the original storage area or place of use, and improperly abandoned. Additional hazardous wastes at POW-3 are due to spills and leaks of petroleum products.

1.6.2 Site Descriptions

At POW-3, WCC performed a field reconnaissance in Summer 1987 and commenced an IRP Stage 3 field investigation in Summer 1988. Six sites were identified at the POW-3 installation: Shed No. 1 (Site 1), Shed No. 2 (Site 2), the Outside Transformer (Site 3), the Inside Transformer (Site 4), the POL Tanks (Site 5), and the Old Landfill (Site 6).

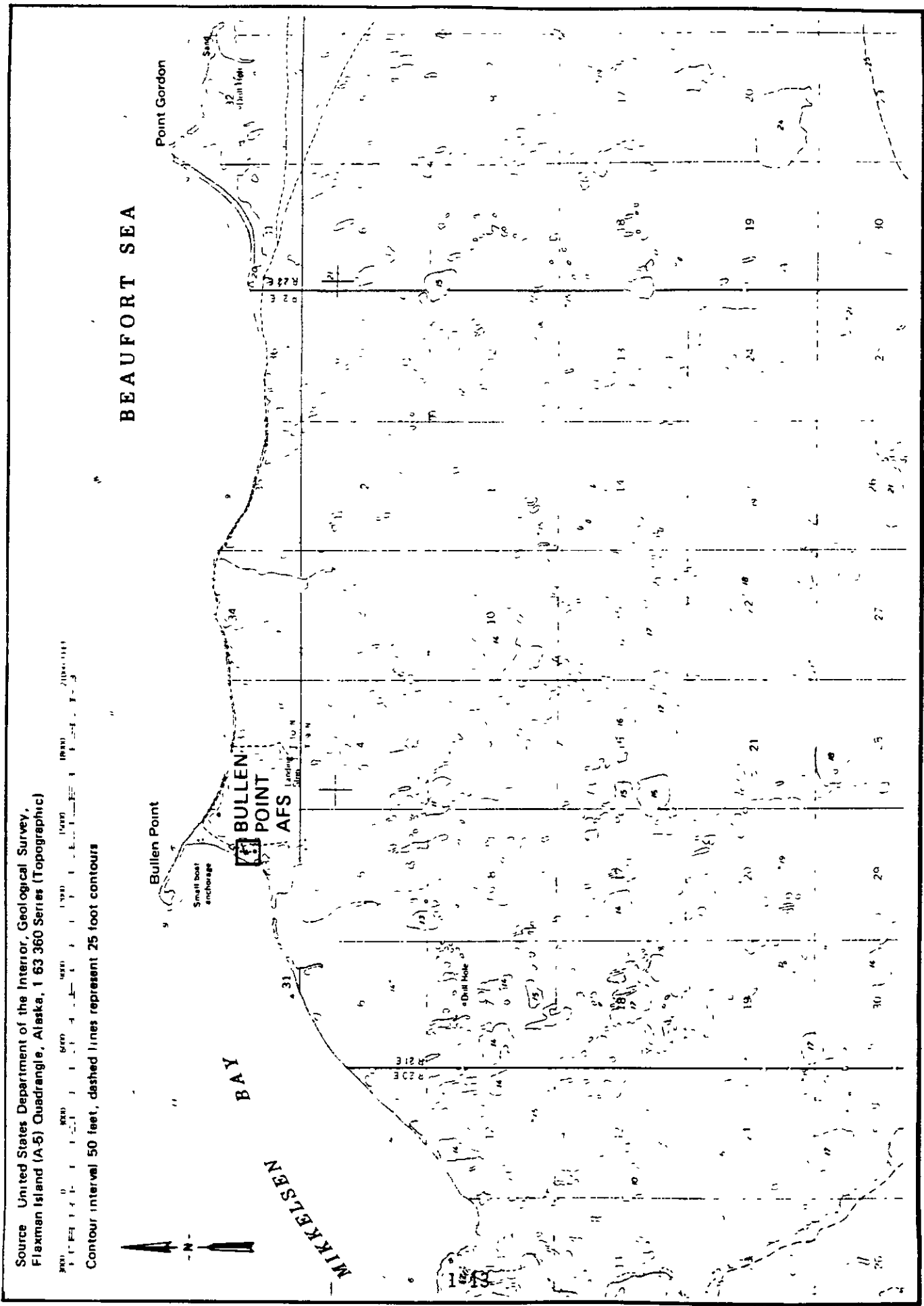


Figure 1-4. BULLEN POINT AFS AREA LOCATION

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Description of the field investigation, including a simple removals program, and identification and characterization of the site contaminants are presented in Section 3.3. The six sites identified for additional field investigations at POW-3 are shown on Figure 1-5 and described below:

1.6.2.1 Shed No. 1 (Site 1). Shed No. 1 is located east of the Module Trains. Several dozen 1- to 5-gallon containers of paint thinner, degreaser, and oils were stored in the shed. Some of the containers were leaking, and spillage from them was observed on the shed's concrete floor. Some of the paint thinner containers were marked with a 1962 date of manufacture. These materials were removed during the Summer 1988 field investigation.

1.6.2.2 Shed No. 2 (Site 2). This shed is located northeast of the Module Trains and immediately south of the POL Tanks. During the WCC 1987 field reconnaissance, 6 inches of liquid, with an inch or more of emulsified oil on the surface, were observed contained on the concrete floor. Simple removals occurred during the WCC 1988 field investigation.

1.6.2.3 Outside Transformer (Site 3). The Outside Transformer is located on a platform, supported by two poles, adjacent to the southernmost Module Train. The transformer shows no signs of leakage on the platform or ground below.

1.6.2.4 Inside Transformer (Site 4). The Inside Transformer is located in the southernmost Module Train, the "transmitter building." During the WCC 1987 field reconnaissance, the transformer oils, suspected of containing Polychlorinated Biphenyls (PCBs), were observed on the floor. Simple removals occurred during the WCC 1988 field investigation.

1.6.2.5 POL Tanks (Site 5). The POL Tanks are located northeast of the Module Train. The tanks appear to have been abandoned with petroleum

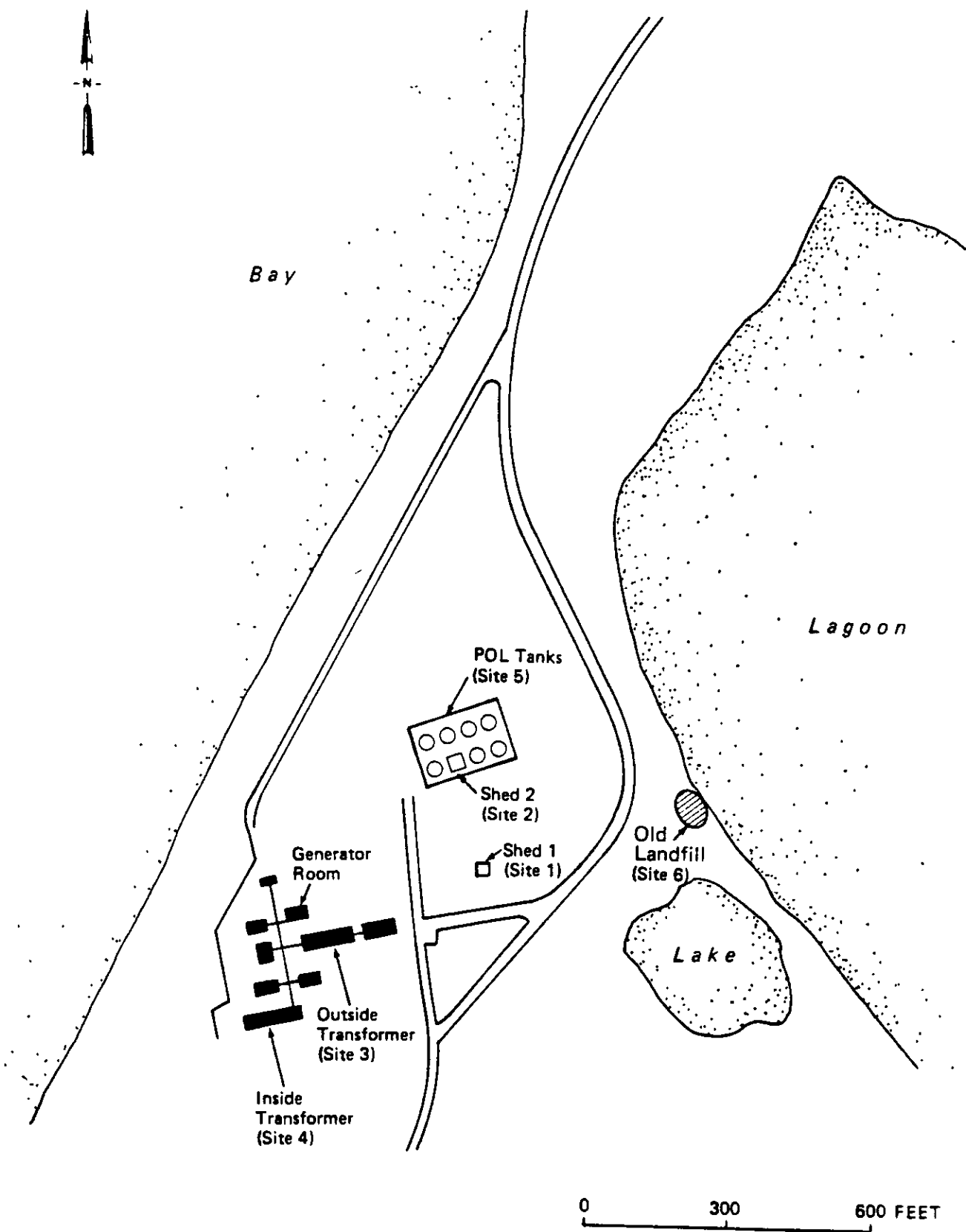


Figure 1-5. BULLEN POINT AFS
SITE LOCATIONS

product or sludge. Liquid level depth gauges show evidence of a few inches of liquid in each tank.

1.6.2.6 Old Landfill (Site 6). The Old Landfill is located near the lagoon east of the Module Trains and access road. This landfill, approximately 1 acre, was used for facility wastes until 1971. The landfill was graded and covered with soil. Minor erosion due to wave action has occurred, but fill contents have not been exposed to date.

1.7 POINT LONELY AFS (POW-1)

POW-1 is located on the northern coast of Alaska (Figures 1-1 and 1-6). This Alaska DEW Line station occupies 2830 acres. An average of 17 personnel are stationed at POW-1, and no villages are located nearby. POW-1 went into operation in 1953 and was turned over to a civilian contractor for operation and maintenance in 1957.

1.7.1 Past Waste Management Practices

Various methods of waste management have been used at POW-1. In the past, wastes were disposed of in a landfill located between the lagoon and access road to the Beaufort Sea. Additional wastes at POW-1 are due to spills and leaks of petroleum products.

1.7.2 Site Descriptions

At POW-1, WCC performed a field reconnaissance in Summer 1987 and commenced an IRP Stage 3 field investigation in Summer 1988. Five sites were identified at the POW-1 installation: the Old Sewage Outfall and Beach Tanks (Sites 25/27), the POL Storage Area (Site 28), the Large Fuel Spill (Site 29/29A), the Old Landfill (Site 31), and the Husky Landfill (Site 32).

Description of the field investigation, and identification and characterization of the site contaminants are presented in Section 3.4.



Woodward-Clyde Consultants

The five sites identified for additional field investigations at POW-1 are shown on Figure 1-7 and described below.

1.7.2.1 Old Sewage Outfall and Beach Tanks (Sites 25/27). These sites are located on the beach north of the station. The Old Sewage Outfall was reportedly northeast of the Beach Tanks. The outfall site does not exist anymore and may have been removed by coastal processes, storms, or grading. The two Beach Tanks are diesel fuel tanks situated in a diked enclosure on a gravel pad. No information is provided in IRP reports on the histories of these two sites.

1.7.2.2 POL Storage Area (Site 28). This site consists of several medium size tanks located adjacent to a small pond near the Husky Oil tank farm, northwest of the Module Trains. The 1987 WCC site visit report stated that the pond was apparently contaminated with petroleum hydrocarbons. The area around the pond on the north and west was grassy and showed no signs of vegetative stress; the area on the south of the pond had a sheen on the water standing or expressed from the soils (WCC 1987).

1.7.2.3 Large Fuel Spill (Sites 29/29A). The Large Fuel Spill is an area of a reported 25,000-gallon spill south of the Husky Oil tank farm (Site 29A). None of the fuel spilled was recovered, according to reports of the incident (CH2M Hill 1981). The affected area is approximately 3 acres in extent and less than 1 foot in depth. Part of the area believed to be affected by the fuel spill is now covered by a gravel pad.

1.7.2.4 Old Landfill (Site 31). This inactive landfill extends into the lagoon north of the main station facilities. The lagoon side of the landfill is eroding and some of the debris in the landfill is exposed. No additional information on the types of waste deposited and the exact dates of operation is available from IRP reports.

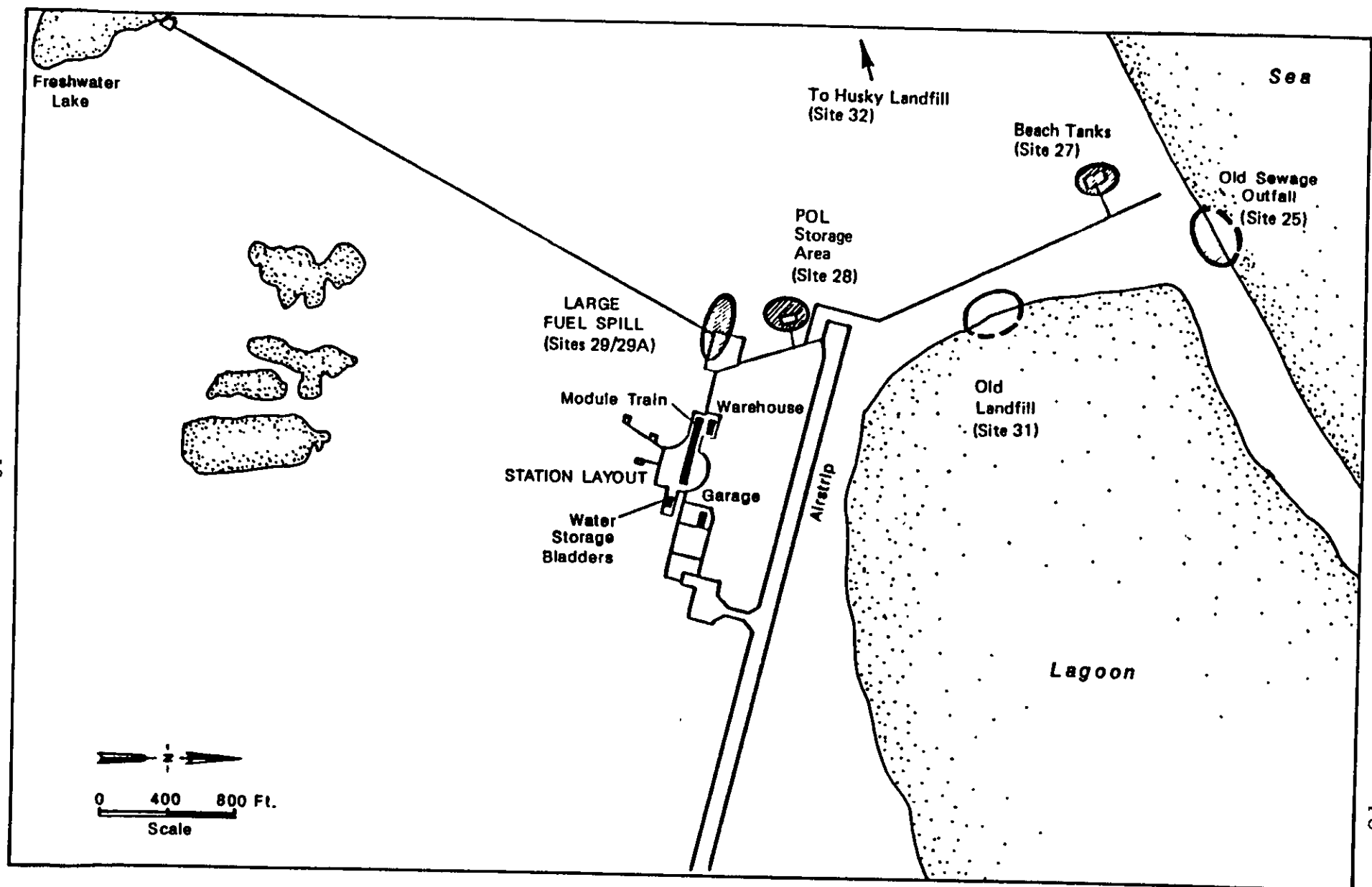


Figure 1-7. POINT LONELY AFS SITE LOCATIONS

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1.7.2.5 Husky Landfill (Site 32). The Husky Landfill, approximately 1 acre in size, received wastes until 1986. It is located at the inactive Husky Oil Exploration Camp approximately 1.5 miles west of the station. The landfill is reported to have received a variety of wastes, including waste oils and solvents, during the years of operation. No additional information on the types of wastes deposited at the Husky Landfill is available from the IRP reports.

2.0 ENVIRONMENTAL SETTING

2.1 INTRODUCTION

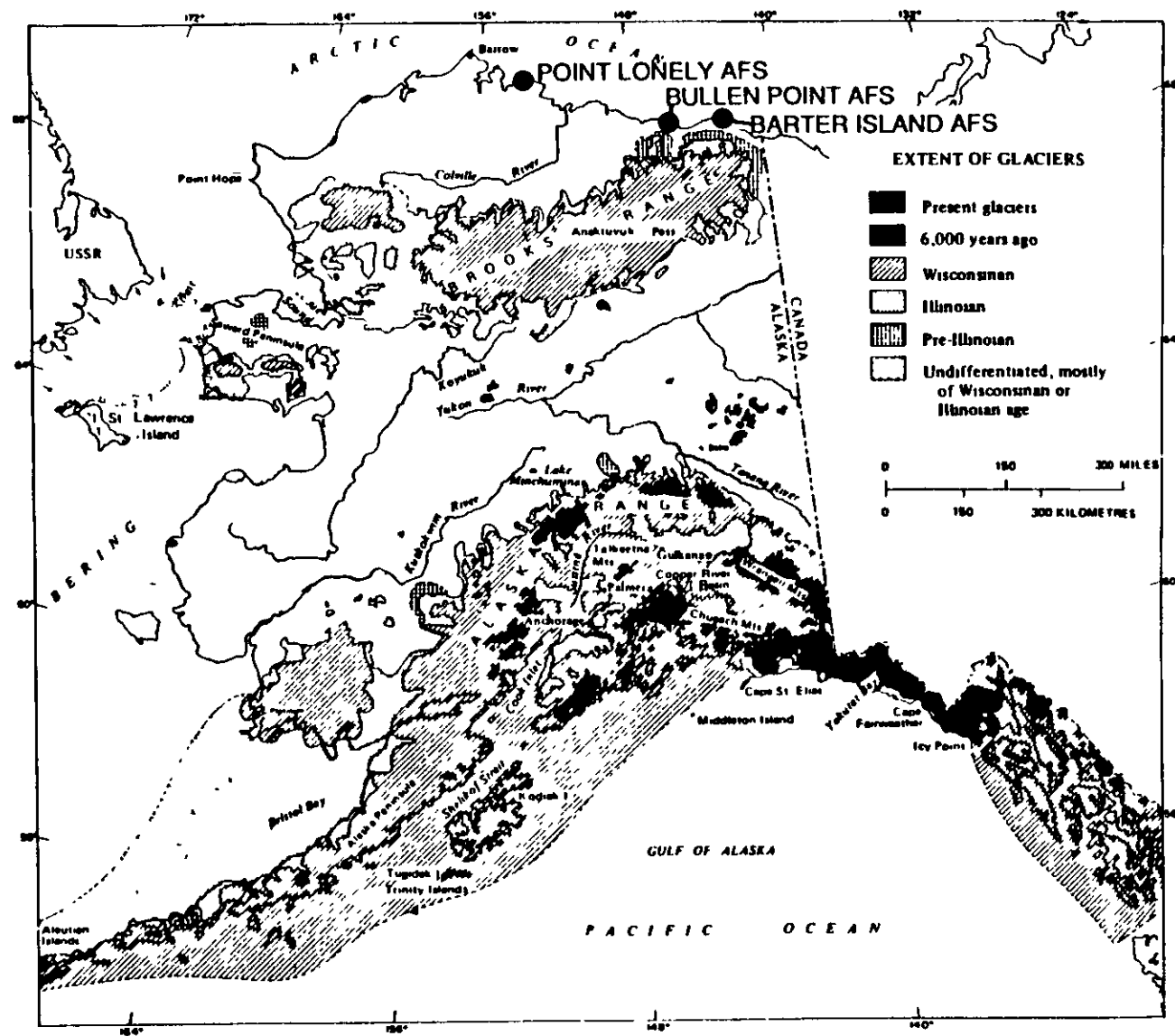
The environmental setting of Barter Island AFS (BAR-M), Bullen Point AFS (POW-3), and Point Lonely AFS (POW-1) is described in this section. The primary emphasis of this discussion is the identification of features or conditions that may affect the migration or remediation of hazardous waste potentially present at these sites.

2.2 GEOLOGY

Geologic units of all the principal time-stratigraphic systems from Precambrian to Quaternary are represented in Alaska. The major interior mountain chains have cores of Precambrian rocks; the core of the Coast Range is generally Mesozoic, bordered by younger sedimentary and volcanic materials. The lower mountains and hills are formed of like materials or of Mesozoic sedimentary rocks (Feulner et al. 1971). The coastal plains are formed by sedimentary materials of Mesozoic to Cenozoic age. Intense structural deformation has continued throughout Alaska's geologic history and has periodically modified the major geologic units by faulting, warping, and folding. The deformational activity is pronounced along the state's Pacific Coast. Active volcanoes are located in the Wrangell Mountains of interior Alaska, the Alaska Peninsula, and in the Aleutian Islands. The predominant structural trend parallels the Pacific Coast.

For the last 2 or 3 million years, frost climates have prevailed in Alaska and the geomorphic processes have been either periglacial (i.e., lying near the glacial) or glacial (Wahrhaftig 1965). During Quaternary time, the geologic period beginning 3 to 2 million years ago and extending through the present, Alaska's landscapes have been reworked by the advance and retreat of the extensive continental glaciers. Changing firn lines delineate the glacial movement. Remnants of the glaciers are present today in the higher elevations of the Coast and Alaska Ranges. Although glacial activity was extensive, it was by no means all encompassing. Glaciation is evident in many parts of the state including the Pacific Mountain System, the Arctic Mountains, the Ahklun Mountains, and southern Seward Peninsula. However, some great expanses received no glacial activity. The principal areas not glaciated include the Intermountain Plateaus, the Arctic Foothills, and the Arctic Coastal Plain. Figure 2-1 depicts the extent of Alaska's glaciated areas.

The glacial activity is significant in that its advance eroded the uplands into block-like groups of mountains with rounded crests separated by U-shaped valleys and low passes. The ridges and peaks that rose above the upper ice sheet elevations remained angular and sharp in appearance (Wahrhaftig 1965). The mountain ranges crowned by such peaks exhibit dramatic relief and their valleys head in near vertical glacier-covered hollows known as cirques. Glaciated lowlands tend to be inconsistent and include such features as moraines, drumlins, kames, eskers, and glacial lake plains. Rock basin and glacial deposit dammed lakes of great size and depth are common features of the glaciated lowland margins. The retreat and melting of the large glaciers produced great quantities of outwash sediment, which has resulted in the filling of many basins and lowlands. Each spring, large quantities of sediment continue to clog many of Alaska's major rivers and streams. The sediments are transported downstream with the flow and are eventually deposited many miles from their points of origin.



SOURCE: MODIFIED FROM Pewe, 1978

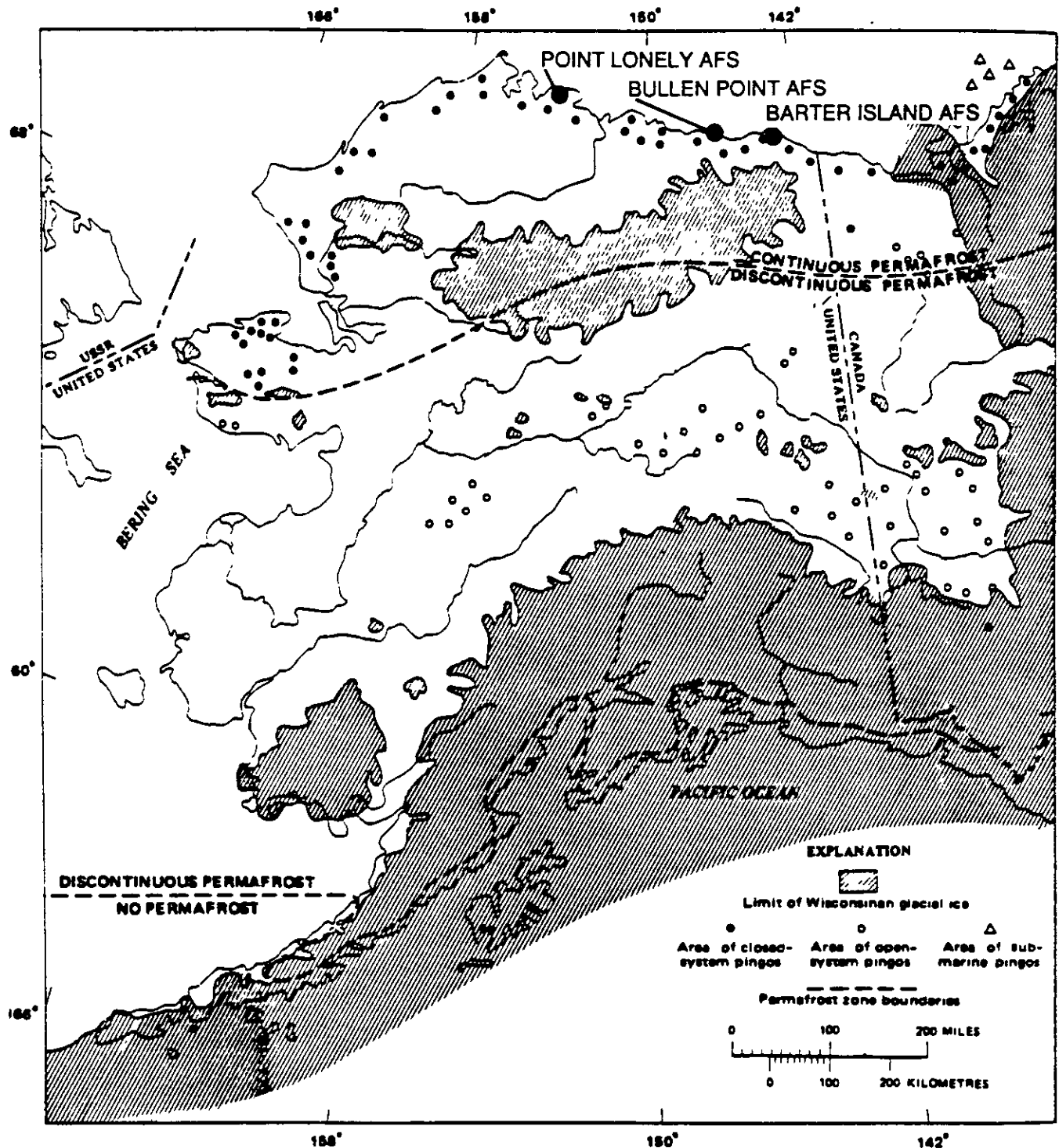
Figur 2-1. QUATERNARY GLACIATION IN ALASKA

One of the most widely distributed Quaternary sediments is loess, a wind-blown silt. Loess occurs in most areas of Alaska below elevations of 1500 feet, ranging in thickness from fractions of an inch to 200 feet. The thickest loess deposits occur in central and western Alaska (Péwé 1975).

Alaska's generally cold climatic regime has produced a condition termed permafrost, a combination of geological, hydrologic, and meteorologic characteristics that produces permanently frozen ground. Permafrost occurs in both unconsolidated sediments and bedrock, and its distribution includes most of the state with the notable exception of the Pacific Coastal area. The occurrence of permafrost varies from thin, scattered zones in the central Alaskan lowlands to sections more than 2132 feet thick near Prudhoe Bay (Selkregg 1975). Permafrost has a significant impact on the flow of groundwater. The distribution of Alaska's permafrost areas is shown on Figure 2-2. Permafrost is mapped in Alaska as continuous, discontinuous, or absent.

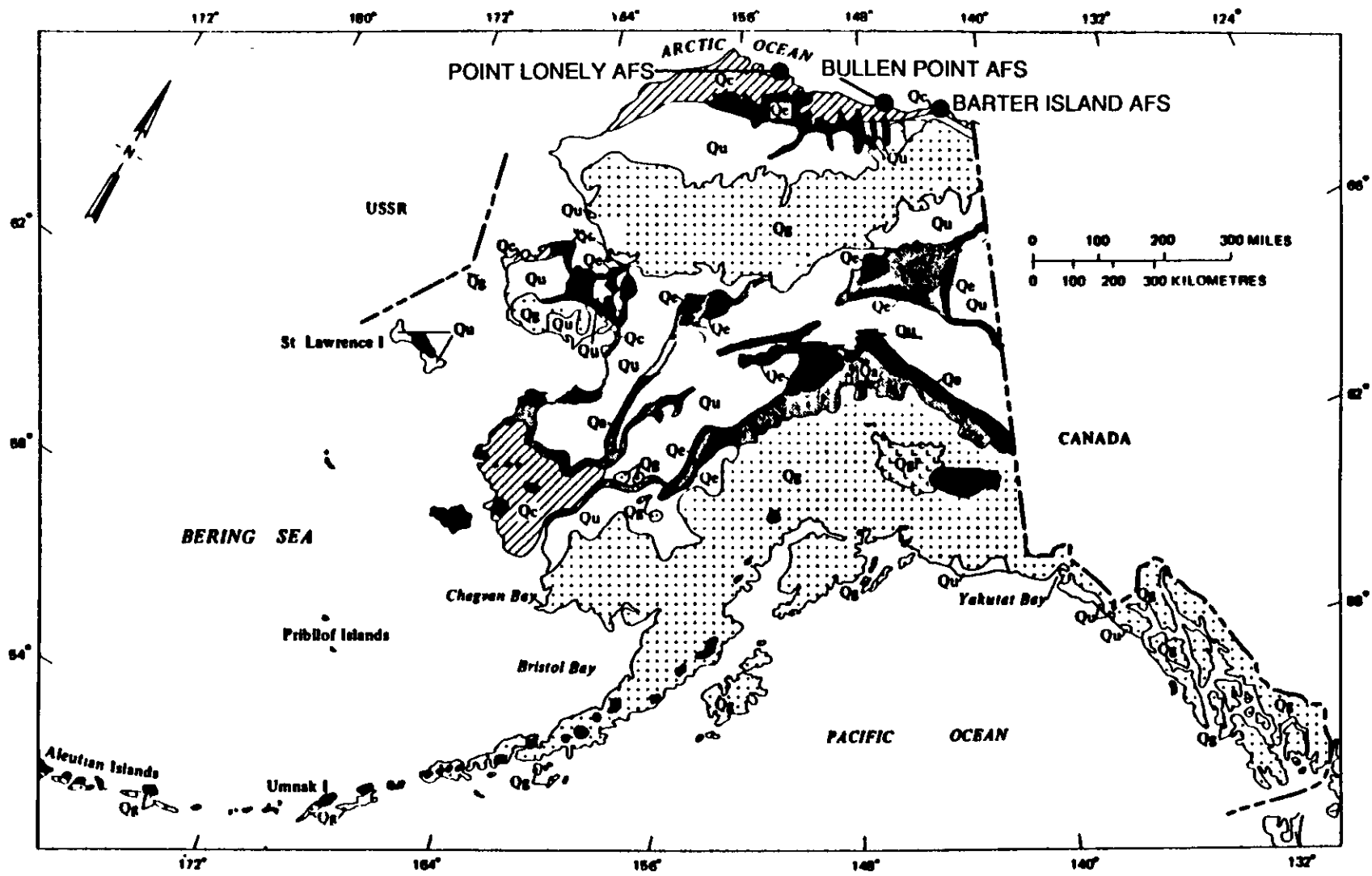
The very strong geologic processes at work today in Alaska have produced a unique environmental setting reflected in the Quaternary Geologic Map of the state as presented on Figure 2-3. For example, Qg (Quaternary glacial deposits) represents the extent of materials common to Alaska's glaciated alpine mountains, and Qa (Quaternary alluvium) illustrates the distribution of the floodplain alluvium of major stream valleys.

The Arctic Coastal Plain is underlain by poorly indurated Pleistocene and Recent sand, gravel, silt, and clay. Beneath these deposits, Tertiary, Cretaceous, and Jurassic sandstones, siltstones, shales, and conglomerates form a 2000- to 12,000-foot-thick sequence that thickens toward the mountains to the south. At greater depths, limestone, siltstone, shale, and sandstone give way to metamorphic rocks of Devonian and older periods. These older systems of rocks, predominantly quartzite schists, marble, and slate, form the regional basement rock. A generally north-south geologic section is presented on Figure 2-4.



SOURCE: MODIFIED FROM P6w6, 1975

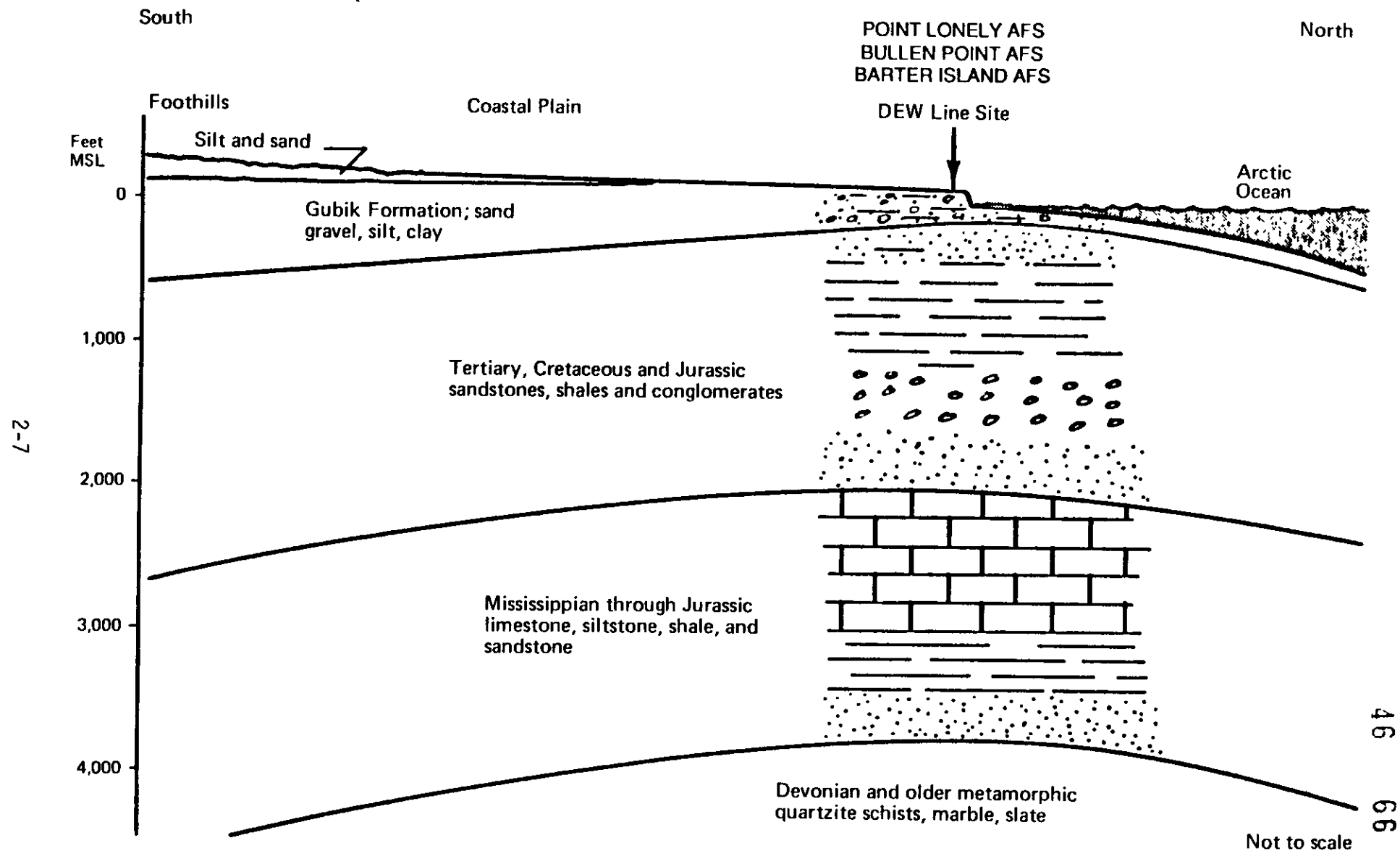
2-6



Sketch map of major regional groups of surficial deposits in Alaska. Qg, glacial and other deposits associated with heavily glaciated alpine mountains; Qgl, glaciolacustrine deposits of larger Pleistocene proglacial lakes; Qu, undifferentiated deposits associated with generally unglaciated uplands and lowlands of the Interior and North Slope; Qa, fluvial deposits; Qe, eolian deposits; Qc, coastal deposits of interbedded marine and terrestrial sediments. Solid black areas are deposits associated with volcanic peaks and flows.

SOURCE: MODIFIED FROM PÉWÉ, 1976

Figure 2-3. QUATERNARY GEOLOGIC MAP OF ALASKA



Source: Modified from CH2M Hill, 1981

Figure 2-4. GENERALIZED NORTH-SOUTH GEOLOGIC CROSS SECTION

Thin accumulations of peat and silty loam overlie the Pleistocene and Recent deposits. Polygonal ground, beaded drainage (a pattern of small pools and short streams connecting them), thermokarst lakes (those lakes formed by the settling or caving in of ground due to the melting of ground ice), and other periglacial features are common throughout the area; these features are indicative of fine-grained permafrost.

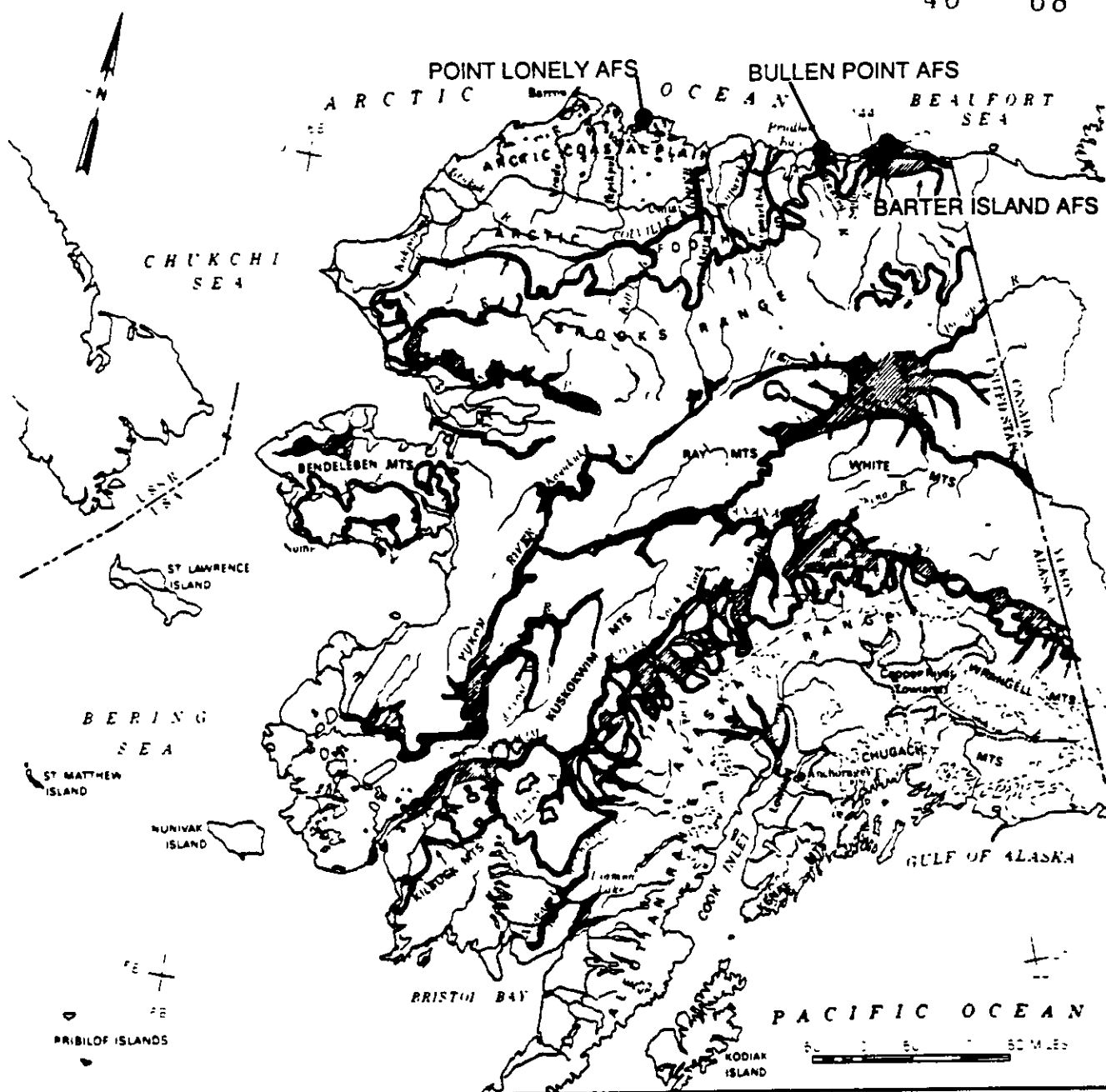
2.3 HYDROGEOLOGY

2.3.1 Groundwater


Alaska's groundwater resources are reported to be highly variable. The most productive groundwater sources are the unconsolidated alluvial aquifers of the state's major river valleys and the glacial outwash aquifers underlying coastal basins and some lowland areas. No major aquifers have been identified in glacial and glaciolacustrine (i.e., derivative of glacial lakes) formations of the interior valleys or in deltaic deposits (Zenone and Anderson 1978). Major bedrock aquifers are restricted to the carbonate rocks of the Brooks Range of Arctic Alaska and along the north side of the Alaska Range. Most bedrock aquifers in Alaska exhibit poor hydraulic qualities and produce only small yields locally.


Alaska has been described as having four generalized geohydrologic environments: an alluvium of floodplains, terraces, and fans in major valleys and in upland and mountain areas; coastal lowland deposits; glacial and glaciolacustrine deposits of the interior valleys; and bedrock aquifers of the uplands and mountain ranges (Williams 1970). The distribution of these four major geohydrologic units throughout Alaska is shown on Figure 2-5. This figure is an attempt to illustrate Alaska's overall groundwater resources; local variations likely occur.


Permafrost has a profound influence on Alaska's groundwater resources. Permafrost is defined by the Glossary of Geology as,





EXPLANATION

 Alluvium of major valleys
Sand, gravel, and silt of flood plains, low terraces,
and alluvial fans

 Coastal-lowland deposits
Chiefly silt and sand and subordinate amounts of
gravel includes sand and gravel of beach, dunes
and spits and sand silt and gravel of deltas
Within limits of Pleistocene glaciation, include till
glaciomarine and glaciostuarine deposits

 Bedrock of mountains and uplands
Chiefly bedrock mantled locally by weathered bedrock
rubble reworked by frost action alluvium and
mass deposits and within limit of Pleistocene
glaciation by glacial deposits

 Limit of Pleistocene glaciation
Unconsolidated deposits within this limit may include
till sand and gravel and silt and clay of glacial
glaciolacustrine, glaciomarine, or glaciostuarine
origin

 Cook Inlet and Copper River Lowlands
Approximate upper limit of lacustrine silt clay
sand gravel and stony silt and clay of extensive
glacial lakes in Copper River Lowland and in
glaciolacustrine glaciostuarine and glaciomarine
deposits in the Cook Inlet lowland

 Major glaciers and ice fields

 Contact

SOURCE: MODIFIED FROM WILLIAMS, 1970

Figure 2-5. GEOHYDROLOGIC UNITS OF
ALASKA

Woodward-Clyde Consultants

any soil, subsoil, or other surficial deposit, or even bedrock, occurring in arctic or subarctic regions at a variable depth beneath the Earth's surface in which a temperature below freezing has existed continuously for a long time (from 2 years to thousands of years). This definition is based exclusively on temperature and disregards the texture, degree of compaction, water content, and lithologic character of the material (American Geological Institute 1972).

Permafrost is variable in thickness and is reported to underlie 20 percent of the world's land area.

Permafrost has a major impact on the relationship of surface water and groundwater in cold regions such as Alaska. The distribution of the principal permafrost regions in Alaska is shown on Figure 2-2. Although groundwater in permafrost regions occurs according to the same geologic and hydrologic principles present in temperate areas, the hydrologic regime is modified in the following ways:

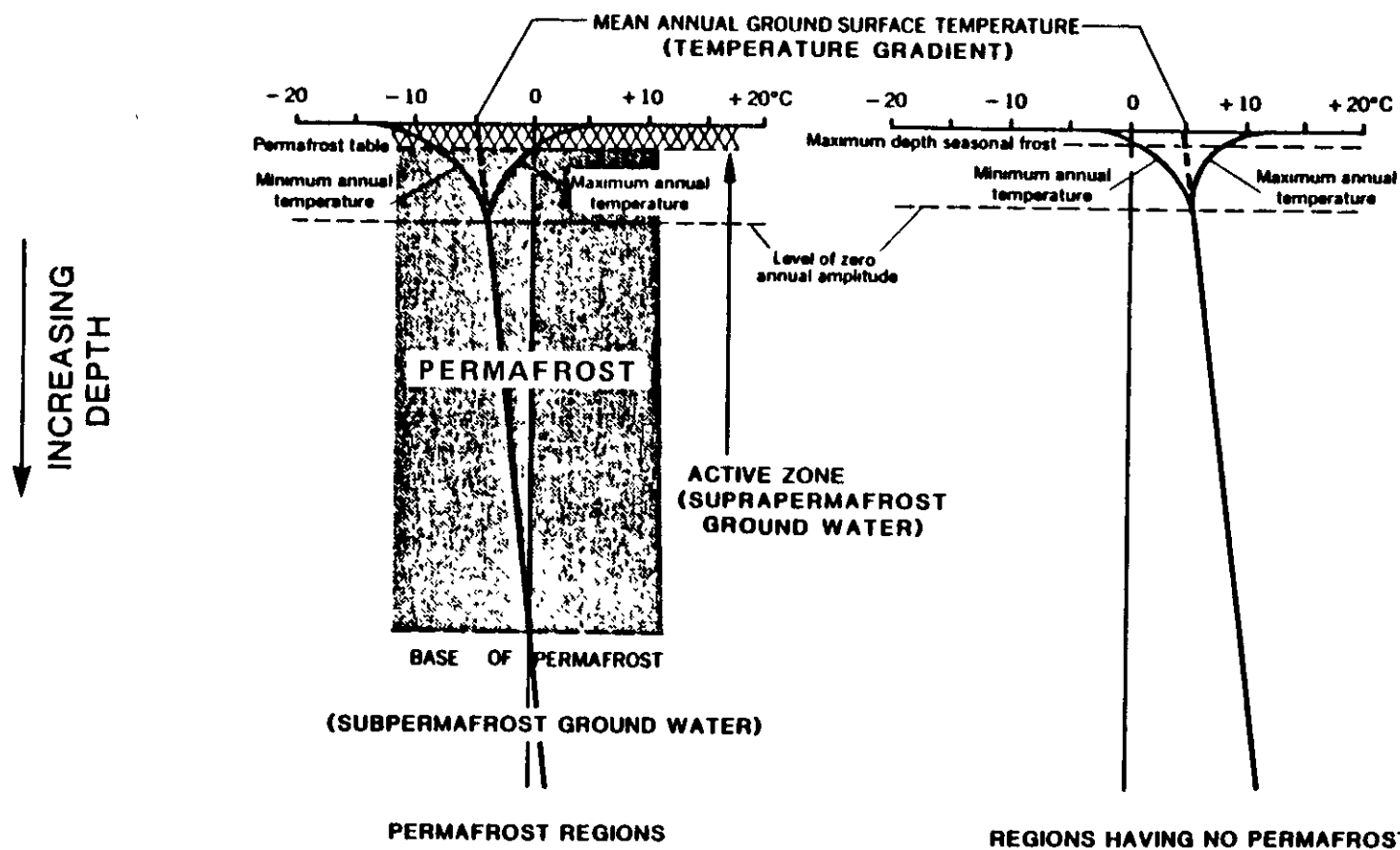
- Permafrost acts as an impermeable barrier to the movement of groundwater, because pore spaces are ice-filled in the zone of saturation. Recharge and discharge are, therefore, limited to unfrozen channels penetrating the permafrost zone. The unfrozen channels are termed perforating taliks. Permafrost restricts the downward percolation of water and increases runoff, enhancing the creation of lakes and swamps (Feulner 1971).
- Permafrost ranges in thickness from a few inches to more than 2000 feet. Therefore, it restricts an aquifer's storage capacity and the number of locations from which groundwater may be withdrawn. It is commonly necessary to drill to greater depths than in similar geologic settings occurring in warm climates. Subpermafrost groundwater occurs beneath the permafrost zone and is usually dependable. Suprapermafrost water occurs in the active zone, above

the permafrost table, and tends to be seasonal; it freezes solid during the cold winter months.

- The groundwater temperature varies from 0 to 4.5° Celsius in permafrost regions because of the low ground temperatures (Williams 1970). Water tends to be more viscous in this temperature range and therefore moves more slowly than in temperate regions.
- Permafrost zones tend to reduce evapotranspiration. The generally low ground temperatures tend to reduce direct evaporation and also transpiration (the escape of moisture through plant tissue into the air) by retarding the growth of vegetation locally. Vegetation growth is enhanced near large surface water bodies where permafrost is absent.

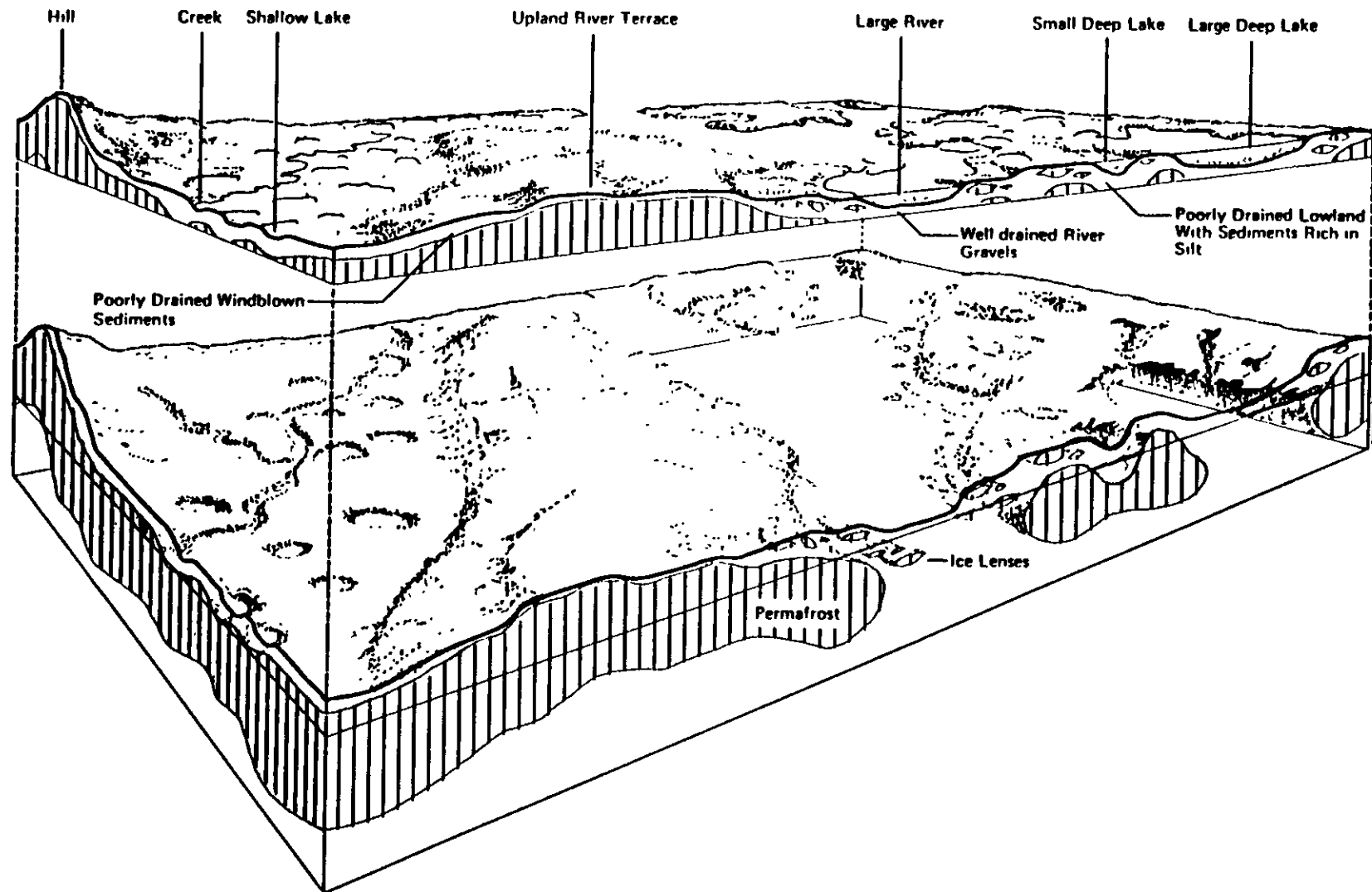
Ground temperatures create the necessary environment in which permafrost can form. A comparison between permafrost regions and temperate zones is shown here as Figure 2-6 (Williams 1970). The segment above the permafrost table is called the active zone, because it freezes and thaws with each seasonal weather change. The permafrost zone remains frozen year-round. The active zone is significant because suprapermfrost groundwater exists in it.

Surface features may have dramatic impacts on the subsurface distribution of permafrost as they influence heat transfer. Heatflow through surface water is greater than through land. Permafrost may be discontinuous or absent near large bodies of water such as rivers or deep lakes. Smaller bodies of water may effect the configuration of the permafrost surface or the total thickness of the condition at any given point. Figure 2-7 is a generalized representation of the relationship of surface features to the underlying permafrost.



SOURCE MODIFIED FROM WILLIAMS, 1970

Figure 2-6. GENERAL TEMPERATURE RELATIONSHIP OF PERMAFROST



SOURCE: MODIFIED FROM SELKREGG, 1976c

A knowledge of surface features and their relationship to subsurface conditions (the study of geomorphology) can be employed to approximate the extent of permafrost. Once the configuration of the permafrost zone has been defined, the investigator will have a reasonable understanding of the potential groundwater resources available in a particular area. Also, such information may be employed to plan the locations of monitoring wells for groundwater quality studies.

2.3.2 Groundwater Recharge, Discharge, and Movement

In Alaska, as in most areas of the world, precipitation is the primary source of groundwater recharge. Alaska's extreme climatic variations have a major impact on this phenomenon, as noted previously. Most recharge occurs beneath the reaches of stream channels that lose flow to underlying aquifers (Zenone and Anderson 1978). Recharge also occurs beneath lakes and summits and slopes of low hills (Williams 1970). These authors estimate that some 25 percent of interior Alaska's streamflow is contributed by base flow. It is believed that perforating taliks extending partially or even completely through permafrost zones along major river channels facilitate recharge and discharge in the continuous permafrost zone. Subpermafrost water is normally fresh, indicating a surface source and circulation. The effect of permafrost in the discontinuous permafrost zone is not quite so pronounced. While the storage capacity of major alluvial aquifers may be reduced by the presence of permafrost, the entire waterbearing zone is not completely frozen (permafrost thickness is normally much less than the total aquifer thickness). Therefore, water can usually be obtained from that portion of the aquifer above or beneath the permafrost zone. In coastal areas, however, brackish water may underlie the permafrost.

The discharge of groundwater in permafrost regions may be indicated by the presence of pingos (large mounds raised by frost action above the permafrost) or in winter by icings. Icings or ice fields form where water seeps upward from the ground, streams, springs, etc. to form a large, level

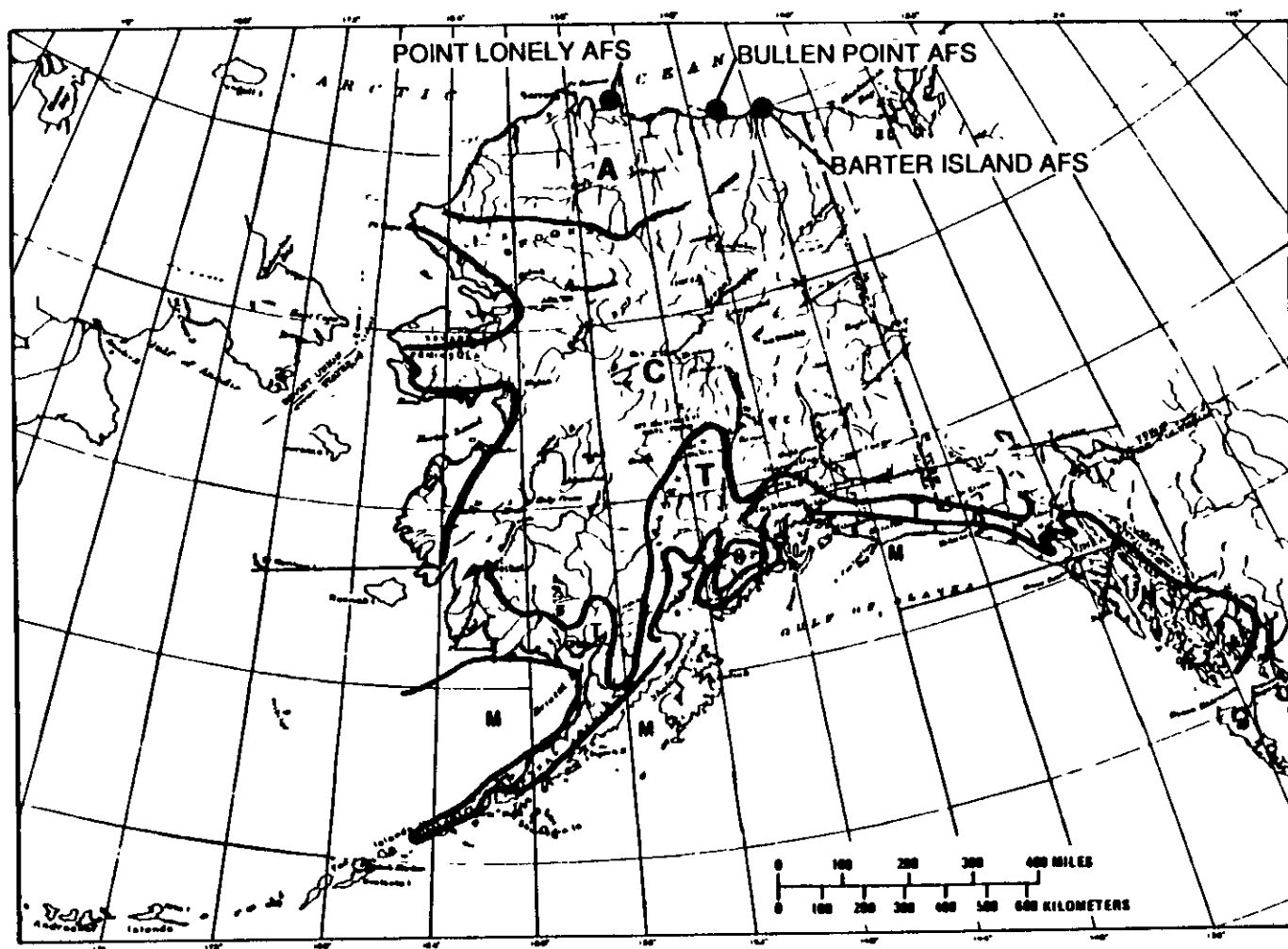
expanse of ice. They are caused by the successive freezing of thin water sheets into thick masses of surface ice. Persistent icing development may be taken to indicate the perennial discharge of groundwater locally.

Groundwater movement is controlled by permafrost. It acts as a barrier to downward percolation and lateral movement, and as a confining layer to subpermafrost water. Confined subpermafrost water usually has an equipotential surface within the permafrost zone; but locally, the static level may be above land surface (Williams 1970). The low groundwater temperatures affect water movement. It has been shown that water existing under low temperature ranges (0-4.5°C) moves more slowly than groundwater in temperate regions due to higher viscosity (Williams 1970). Groundwater velocity is inversely proportional to viscosity.

2.4 CLIMATOLOGY

Due to its size and geographic complexity, the state of Alaska encompasses four major climatic zones that have been established on the basis of similar temperature and precipitation values. Figure 2-8 depicts the distribution of the Alaskan climatic zones. Rainfall is highly variable across Alaska, ranging from 5 inches annually in the arctic climatic zone to some 300 inches annually along the southeast coast in the maritime zone (NOAA 1983; Zenone and Anderson 1978). The dramatic variation in rainfall results from orographic (i.e., mountain-caused) effects related to topography and exposure. Coastal mountain ranges receive the most rainfall and interior lowlands receive the least.

The three DEW Line stations are located in the Arctic zone. This environment consists of cold average temperatures with strong seaward winds blowing across each station. Although the region is continuously wet in summer and dotted with lakes, the amount of precipitation is low. Therefore, this region is classified as a frozen desert.



A REPRESENTS ARCTIC; C, CONTINENTAL; T, TRANSITIONAL; AND M, MARITIME.

SOURCE: MODIFIED FROM ZENONE AND ANDERSON, 1978

Figure 2-8. ALASKA CLIMATIC ZONES

2.5 NATURAL RESOURCES

Significant natural resources may exist in the Arctic Coastal Plain, primarily in the form of fossil fuel and uranium deposits. However, BAR-M is located within the limits of the Arctic National Wildlife Refuge, a federally protected environment (U.S. Fish and Wildlife Service 1988).

2.6 BIOLOGICAL/ECOLOGICAL RESOURCES

Arctic ecosystems can be treated as stable systems only over immense geographic areas, and they require long periods of time to recover following disturbance. The two ecosystems relevant to the DEW Line stations are the coastal and marine zone, and the wet sedge meadows.

2.6.1 Coastal and Marine Zone

The Beaufort Sea is shallow, and the near-shore and shore areas are subject to ice scour except where lagoons, bays, and inlets are protected by barrier islands and spits. These protected waters, together with the estuaries of the major rivers, have the greatest primary food productivity of this zone. Marine mammals and fish are ultimately dependent on this productivity. Emergent grasses and sedges occur in brackish marsh ponds, and submergent plants grow in some protected lagoons (U.S. Fish and Wildlife Service 1988).

Walrus, ringed seals, bearded seals, and beluga whales are the zone's common marine mammals. In winter, the ringed seal is the most common species using the near-shore ice environment. The ringed seal is preyed upon by polar bear (U.S. Fish and Wildlife Service 1988).

There is little diversity of marine fish in the Arctic ecosystem. Of the 60 species reported for the Arctic coast, many are rare. Thirteen of the species are anadromous, i.e., they migrate upriver to breed, so they spend only part of their life cycles in this marine environment (U.S. Fish and Wildlife Service 1988).

Because the barrier islands are low-lying and exposed to ice scouring and summer storms, vegetation is sparse or absent. These islands provide nesting sites protected from predation for common eiders and glaucous gulls. Especially during post-breeding molt and the fall migration, the shores of barrier islands and the lagoons are used by large numbers of shorebirds and waterfowl (e.g., oldsquaws, brant, phalarope, etc.). Densities of more than 620 birds per mile of shoreline have been reported as being common along barrier island beaches in August and September (U.S. Fish and Wildlife Service 1988).

2.6.2 Wet Sedge Meadows

About one-half of the coastal plain consists of wet sedge meadows. These meadows are characterized by peaty soils with a shallow active layer above the continuous permafrost and a water-saturated surface in summer. On the coastal plain, the meadow plant community occurs in a mosaic with innumerable small, relatively shallow lakes. The microrelief features associated with low and high center ice-wedge polygons provide drier sites supporting a variety of plant species. A few dwarf woody plants and lichens occur on the drier sites. Pendent grass is an important emergent species on the shorelines and in the shallowest zones of ponds; it is extensively used by waterfowl and shorebirds (U.S. Fish and Wildlife Service 1988).

Plant consumption in wet sedge meadows is dominated by a single species, the brown lemming. This rodent shows extreme fluctuations in numbers in 3- to 5-year cycles. These cycles are of such a magnitude as to greatly influence the vegetation, the competitors, and the predators of this species and, indirectly, all other components of the ecosystem (U.S. Fish and Wildlife Service 1988).

2.6.3 Transzonal Fauna

The coastal and meadow zones also support or are frequented by several species of large mammals. Porcupine caribou, moose, musk ox, and polar bear are among the species that are found in these zones (U.S. Fish and Wildlife Service 1988).

2.7 HISTORIC RESOURCES

The USAF submitted an application to determine the eligibility of the Alaska DEW Line stations for the National Register of Historic Places. The Alaska State Historical Preservation Officer (SHPO) has concurred with the USAF that the Alaska DEW Line stations are historically significant; SHPO made a preliminary determination on March 9, 1987 that the Alaska DEW Line stations are eligible for the National Register of Historic Places, pending further information to be provided by the USAF. Properties determined to be eligible for the National Register of Historic Places are accorded the same protections as properties listed on the National Register (Alaska State Historic Preservation Office 1989). Consultation with Alaska SHPO may be required and would be appropriate before any alterations on the manmade environment are performed for hazardous waste cleanup at these potentially eligible National Register sites.

2.8 BARTER ISLAND AFS (BAR-M) ENVIRONMENTAL SETTING

2.8.1 Geographic Setting

BAR-M, the easternmost of the DEW Line stations, is located on the northern coast of Alaska near the Canadian border. The facility is sited on 4353 acres of low-lying tundra. The area around BAR-M is nearly flat, with land surface elevation at all points of the installation within 50 feet above sea level (Figure 1-2).

2.8.2 Hydrology

Several small streams cross the BAR-M facility. The drainage is generally to the north. Surface runoff occurs as sheet flow and ephemeral streams, and may drain into larger streams or directly to the ocean. Infiltration to shallow depths may occur during summer months when the active layer thaws (Figure 2-9).

Several large and small lakes are located in the vicinity of the BAR-M (Figure 1-2). They are generally less than 10 feet deep and may freeze to the bottom during the winter months. Barter Island is located in an area where large freshwater lakes are the only source of drinking water. Drinking water for BAR-M is provided by a large lake to the south of the Module Trains.

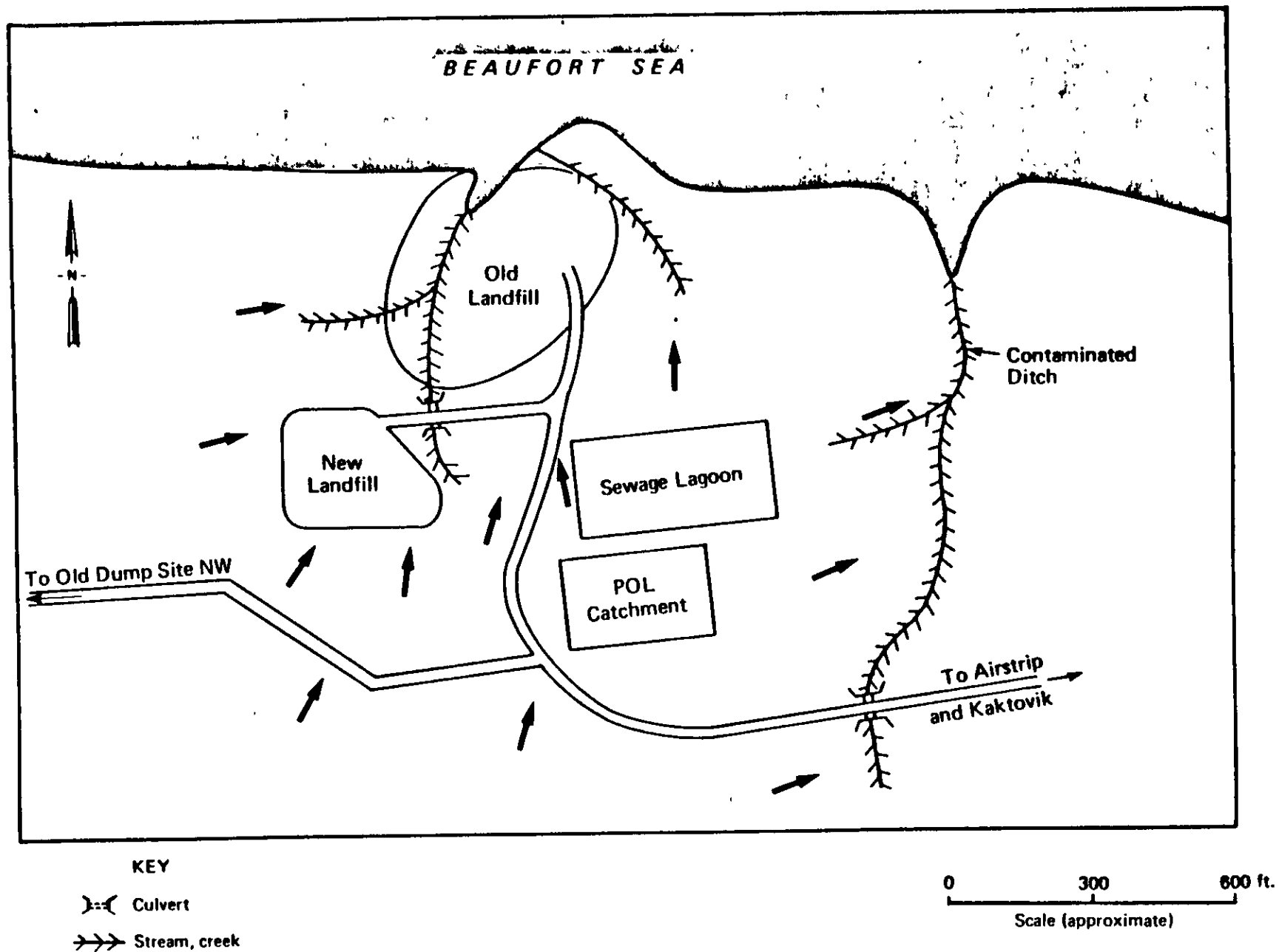
2.8.3 Climate/Air Quality

At BAR-M, precipitation averages 7 inches per year, including 45 inches of snow. Average daily minimum and maximum temperatures in summer are 30°F and 46°F, respectively. In winter, these temperatures are -20°F and -6°F, respectively. Temperature extremes for the period of record (1959 to 1974) were -59°F and 75°F. In the Arctic Region, strong winds coupled with cold winter temperatures can cause the wind chill factor to reach below -100°F (Selkregg 1974-1976).

Due to the limited sources of air pollution in the vicinity of BAR-M, air quality is expected to be good. However, air pollution may be present in the immediate area due to the use of fossil fuels for heating, cooking, internal combustion engine operation, and the burning of wastes at the BAR-M landfill.

2.8.4 Human Resources

BAR-M consists of 4353 acres of land on Barter Island. BAR-M is located approximately 646 miles north of Anchorage and 382 miles north of Fairbanks. Accommodations for up to 75 personnel are available at BAR-M.



Figur 2-9. SURFACE DRAINAGE BARTER ISLAND AFS

46 81

The native village of Kaktovik, population 250, is located approximately $\frac{1}{2}$ mile southeast of the main living area at BAR-M. Kaktovik was incorporated as a second-class city in 1972.

Economic opportunities in Kaktovik are limited due to the isolated location of this most easterly North Slope Borough village. Jobs are provided by a store, local government, the school, a clinic, a local flying service, and construction projects for village facilities. The sale of arts and crafts items, particularly baleen baskets, ivory carvings, and Eskimo clothing, also brings cash income to some individuals.

Subsistence hunting, fishing, and trapping make up the major portion of the economy of Kaktovik. People in the village are heavily dependent on subsistence activities, whether or not they work for cash.

2.9 PREVIOUS BAR-M IRP ACTIVITIES

The CH2M Hill Phase I Report reviewed and identified five BAR-M sites as having the highest potential for contaminant migration and warranting additional study: Old Dump Site (Old Landfill, Site 1), Waste Petroleum Disposal (POL Catchment Area, Site 3), Current Dump Site (New Landfill, Site 4), Drainage Cut Contamination (Contaminated Ditch, Site 8), and Old Dump Site N.W. (Site 9). The Phase I Report also recommended additional soil sampling at the Old Dump Site and the Current Dump Site, and additional surface water sampling at the Waste Petroleum Disposal, the Drainage Cut Contamination, and the Old Dump Site N.W. The Phase II, Stage 1 Report by Dames & Moore completed this recommended sampling program. The Phase II, Stage 2 field investigation by Dames & Moore consisted of collecting soil and surface water samples upgradient and downgradient of the Old Dump Site; and collecting surface water samples upgradient and downgradient of the Old Dump Site, Waste Petroleum Disposal, Current Dump Site, Drainage Cut Contamination, and Old Dump Site N.W.

During the 1987 WCC site visit to BAR-M, additional surface soil and water sampling was recommended for the Old Landfill, New Landfill, Sewage Lagoon, POL Catchment Area, and Contaminated Ditch sites. The Old Dump Site N.W. was not located during the site visit, and was not detailed for additional sampling. Although the Sewage Lagoon is not an IRP site, it may contribute to biological contamination at the BAR-M IRP sites. The 1988 WCC Stage 3 effort carried out the sampling program developed from the previous IRP activities and the 1987 WCC site visit (Section 3.2).

2.9.1 CH2M Hill IRP Phase I Report, 1981

CH2M Hill performed the Phase I Problem Identification/Records Search in Summer 1981. The following sites at BAR-M were not included in the site rating assessment by CH2M Hill, because they were reviewed and identified as areas having no potential for contaminant migration and were, therefore, excluded from the site rating assessment and eliminated from further study:

- PCB Transformers (Site 5)
- Fuel Storage Tank (Site 6)
- Storage Area (Site 7)
- POL Storage Tanks (Site 10)
- Diesel Fuel Tank (Site 11).

The following sites were included in the site rating assessment, because they were reviewed and identified as areas not considered to pose a significant hazard for migration of contaminants and did not warrant additional study:

- Sewage Lagoon (Site 2)
- Old Airport Dump Site (Site 12).

The following sites were reviewed and identified as areas having the highest potential for contaminant migration and, therefore, warranted additional study:

- Old Dump Site (Old Landfill, Site 1)
- Waste Petroleum Disposal (POL Catchment Area, Site 3)
- Current Dump Site (New Landfill, Site 4)
- Drainage Cut Contamination (Contaminated Ditch, Site 8)
- Old Dump Site N.W. (Site 9).

CH2M Hill recommended additional soil sampling at Sites 1 and 4, and surface water sampling at Sites 3, 8, and 9.

2.9.2 Dames & Moore IRP Phase II, Stage 1 Report, 1986

The Dames & Moore 1986 investigation constituted the Phase II, Stage 1 field evaluation. The field investigation by Dames & Moore consisted of collecting two soil grab samples per site at Sites 1 and 4, and surface water samples at Sites 3, 8, and 9. The soil samples were analyzed for total organic halogens (TOX), lead, phenols, and PCBs. The surface water samples were analyzed for total organic carbon (TOC), TOX, lead, phenols, oil and grease, and PCBs.

2.9.2.1 Old Dump Site (Old Landfill, Site 1). At Site 1, soil samples were reported to have TOX concentrations below the detection limit of 5 mg/kg (parts per million). Soil samples collected from the adjacent small stream were reported with lead concentrations from below the detection limit of 10 to 76 mg/kg. In addition, the small stream soil samples were tested for PCBs and reported with concentrations from below the detection limit of 0.5 to 0.72 mg/kg. Phenols were reported below the contract detection limit of 1 mg/kg.

2.9.2.2 Waste Petroleum Disposal (POL Catchment Area, Site 3). Surface water samples collected from the nearby pond were reported to have elevated concentrations of TOC at 51 mg/L, TOX at 1.2 mg/L, and oil and grease at 36 mg/L. Lead, PCBs, and phenols were not tested for in the water samples.

2.9.2.3 Current Dump Site (New Landfill, Site 4). Soil samples were collected downgradient of Site 4. Lead was detected in the soil samples at concentrations from below detection limit (10 mg/kg) to 52 mg/kg. TOX, phenols, and PCBs were reported to be below the contract detection limits of 5, 1, and 5 mg/kg, respectively.

2.9.2.4 Drainage Cut Contamination (Contaminated Ditch, Site 8). The water samples from this drainage ditch had a reported TOX concentration of 0.18 mg/L. Lead was reported at the detection limit of 0.01 mg/L. TOC, detected at 19 mg/L, was reported within the range of anticipated background levels. Phenols, oil and grease, and PCBs were reported below the contract detection limits of 0.01, 5, and 0.0005 mg/L, respectively.

2.9.2.5 Old Dump Site N.W. (Site 9). The water sample collected downgradient of Site 9 indicated an elevated concentration of TOX at 0.19 mg/L. TOC, detected at 31 mg/L, was reported within the range of background levels. Lead and PCBs were reported below the contract detection limits, and phenols and oil and grease were not tested.

2.9.3 Dames & Moore IRP Phase II, Stage 2 Report, 1987

The Phase II, Stage 2 field investigation by Dames & Moore in 1987 was designed to confirm the presence of contamination within the specified areas of investigation, determine the magnitude of contamination and potential for migration of those contaminants in the environmental media, identify public health and environmental hazards of migrating pollutants, and identify additional investigation required.

The Phase II, Stage 2 field investigation consisted of collecting soil grab samples upgradient and downgradient of Site 1, and collecting surface water samples upgradient and downgradient of Sites 1, 3, 4, 8, and 9.

The Phase II, Stage 1 analyses used indicator parameters in a screening process as a basis for the Phase II, Stage 2 analyses. The Stage 2 investigation included group analyses for specific compounds. The group parameters for analyses of the water samples were purgeable halocarbons and total petroleum hydrocarbons (TPHs). Analyses of 11 purgeable halocarbon components were done, and only those greater than or equal to the detection limit are discussed below. Review of these laboratory data by WCC indicates that trichlorofluoromethane and methylene chloride were detected in surface water samples. These compounds are common laboratory solvents and are not likely associated with site contamination. Therefore, they can be treated as negligible and are not considered further.

2.9.3.1 Old Dump Site (Old Landfill, Site 1). At Site 1, soil samples tested for PCBs were reported with concentrations from below the contract detection limit of 0.02 to 0.34 mg/kg. The following purgeable halocarbons and concentrations were reported for surface water samples at Site 1: bromomethane (ND to 15 $\mu\text{g/L}$), 1,1-dibromochloromethane (1.9 to 4.1 $\mu\text{g/L}$), trans-1,2-dichloroethene (0.6 to 2.0 $\mu\text{g/L}$), 1,1,1-trichloroethane (ND to 1.1 $\mu\text{g/L}$), and trichloroethene (110 to 290 $\mu\text{g/L}$).

2.9.3.2 Waste Petroleum Disposal (POL Catchment Area, Site 3). The following purgeable halocarbons and concentrations were reported for surface water samples at Site 3: trans-1,2-dichloroethene (ND to 0.43 $\mu\text{g/L}$), and trichloroethene (ND to 0.76 $\mu\text{g/L}$). In addition, TPHs were reported at 2.2 to 4.4 mg/L in the surface water samples.

2.9.3.3 Current Dump Site (New Landfill, Site 4). The surface water samples collected at Site 4 were tested for purgeable halocarbons and concentrations were reported as follows: 1,1-dichloroethane (ND to 1.9 $\mu\text{g/L}$).

2.9.3.4 Drainage Cut Contamination (Contaminated Ditch, Site 8). The water samples for this drainage ditch had the following purgeable halocarbons reported: trans-1,2-dichloroethene (ND to 0.62 $\mu\text{g/L}$) and trichloroethene (ND to 1.5 $\mu\text{g/L}$).

2.9.3.5 Old Dump Site N.W. (Site 9). The surface water samples collected at Site 9 were tested for purgeable halocarbons and none were detected.

2.10 BULLEN POINT AFS (POW-3) ENVIRONMENTAL SETTING

2.10.1 Geographic Setting

POW-3 is located on the north coast of Alaska. The facility is sited on 620 acres of low-lying tundra. The area around POW-3 is nearly flat, with land surface elevations at all points of the installation within 10 feet above mean sea level (Figure 1-3).

2.10.2 Hydrology

Several small streams cross the POW-3 facility. The drainage is generally to the north. Surface drainage occurs as sheetflow and ephemeral streams and may drain into larger streams or directly to the ocean. Infiltration to very shallow depths occurs during summer months when the active layer thaws (Figure 2-10).

Several large and small lakes are located in the vicinity of POW-3 (Figure 1-3). They are generally less than 10 feet deep, and most remain frozen during the winter months. POW-3 is located in an area where large freshwater lakes were the only source of drinking water prior to closure. Drinking water for POW-3 was provided by a lake to the south of the facility.

2.10.3 Climate/Air Quality

At POW-3, precipitation averages 5 to 7 inches per year. At BAR-M, less than 100 miles to the east, average daily minimum and maximum

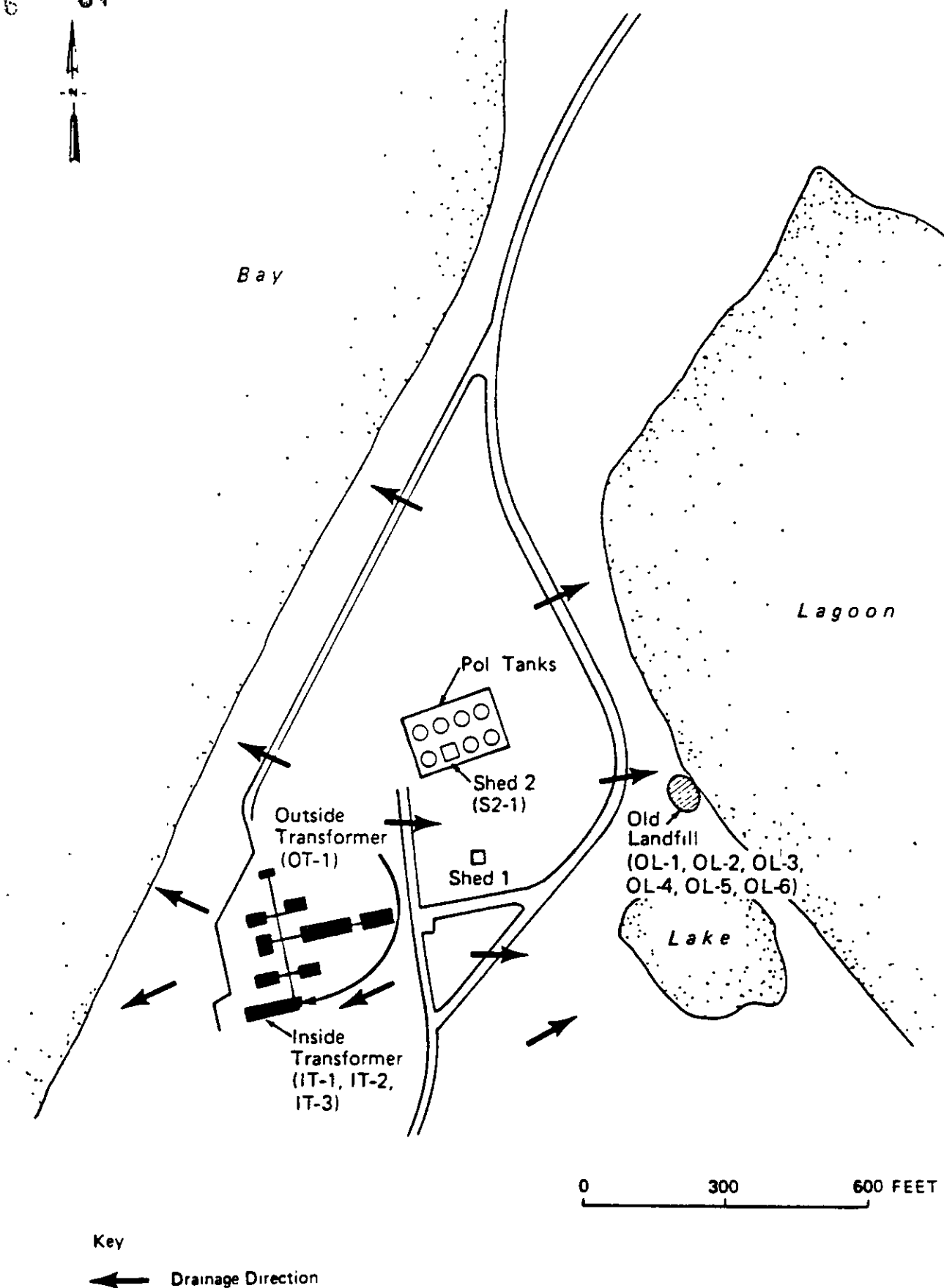
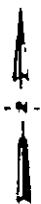


Figure 2-10. SURFACE DRAINAGE
BULLEN POINT AFS

temperatures in the summer are 30°F and 46°F, respectively. In winter, these temperatures are -20°F and -6°F, respectively. Temperature extremes for the period of record (1959-1974) were -59°F and 75°F. In the Arctic Region, strong winds coupled with cold winter temperatures can cause the wind chill factor to reach below -100°F (Selkregg 1974-1976).

2.10.4 Human Resources

POW-3 consists of 620 acres of land located approximately 635 miles north of Anchorage. Currently, no human activities exist on a continuing basis near this isolated and abandoned facility. On occasion, the airstrip is used by charter aircraft for a hunting or fishing party. The locality of Bullen was an Eskimo campsite shown on a 1902 manuscript map by S.J. Marsh.

2.11 PREVIOUS POW-3 IRP ACTIVITIES

The CH2M Hill Phase I Report reviewed and identified the Old Dump Site East, Site 13 (Old Landfill, Site 6) as an area at POW-3 having a very high potential for contaminant migration and, therefore, warranted additional study. The Phase II, Stage 1 report by Dames & Moore presented the results of the surface water sampling of the Old Dump Site East. During the Phase II, Stage 2 investigation by Dames & Moore, additional surface water samples were taken at the Old Dump Site East. During the 1987 WCC site visit, the Old Landfill, POL tanks, Shed No. 1, Shed No. 2, the Outside Transformer, and the Inside Transformer sites were identified for further investigation and field sampling. The 1988 WCC Stage 3 effort carried out the sampling program developed during the previous IRP activities and the 1987 WCC site visit (Section 3.3).

2.11.1 CH2M Hill IRP Phase I Report, 1981

At POW-3, the following sites were not included in the site rating assessment; because they were reviewed and identified as areas having no potential for contaminant migration and were, therefore, not included in the site rating assessment and eliminated from further study:

- Vehicle Storage Area (Site 14)
- Garage (Site 15).

The following site was reviewed and identified as an area having a very high potential for contaminant migration warranting additional study:

- Old Dump Site East, Site 13 (Old Landfill, Site 6).

It was recommended that additional study including a limited surface water sampling program be done at Site 13.

2.11.2 Dames & Moore IRP Phase II, Stage 1 Report, 1986

The Phase II, Stage 1 field evaluation by Dames & Moore was conducted in 1986.

2.11.2.1 Old Dump Site East, Site 13 (Old Landfill, Site 6). One surface water sample from Site 13 was analyzed for TOC, TOX, total lead, phenols, oil and grease, and PCBs. The following concentrations were reported: TOC (6.0 mg/L), TOX (1.1 mg/L), and lead (0.05 mg/L). The phenols and PCBs were below the contract detection limits (0.01 and 0.0005 mg/L, respectively). Oil and grease was not tested for in surface water samples.

2.11.3 Dames & Moore IRP Phase II, Stage 2 Report, 1987

The Phase II, Stage 2 field investigation by Dames & Moore in 1987 was designed to confirm the presence of contamination within the specified area of investigation, determine the magnitude of contamination and potential for migration of the contaminants in the environment, identify public health and environmental hazards of migrating pollutants, and identify additional investigation required.

2.11.3.1 Old Dump Site East, Site 13 (Old Landfill, Site 6). A surface water sample was collected from Site 13. The Phase II, Stage 1 analysis used indicator parameters in a screening process on which to base the Phase II, Stage 2 analyses. The Stage 2 investigation included group analyses for specific compounds. The group parameter for analyses of the water sample was purgeable halocarbons. Analyses of eleven purgeable halocarbon components were completed, and all results were ND.

2.12 POINT LONELY AFS (POW-1) ENVIRONMENTAL SETTING

2.12.1 Geographic Setting

POW-1 is located on the north coast of Alaska. The facility is sited on 2830 acres of low-lying tundra. The area around POW-1 is nearly flat, with land surface elevations at all points of the installation within 20 feet above mean sea level (Figure 1-4).

2.12.2 Hydrology

Several small streams cross the POW-1 facility. The drainage is radial, away from the facility. Surface drainage occurs as sheetflow and ephemeral streams and may drain into larger streams or directly to the ocean. Infiltration to very shallow depths occurs during summer months when the active layer thaws (Figure 2-11).

Several large and small lakes are located in the vicinity of POW-1 (Figure 1-4). They are generally less than 10 feet deep, and most remain frozen during the winter and early summer months. POW-1 is located in an area where large freshwater lakes are the only source of drinking water. Drinking water for POW-1 is provided by a large lake to the southeast of the Module Trains.

2.12.3 Climate/Air Quality

At POW-1, precipitation averages approximately 4 inches per year. At Barrow (POW-M), less than 100 miles to the west, average daily minimum and

2-32

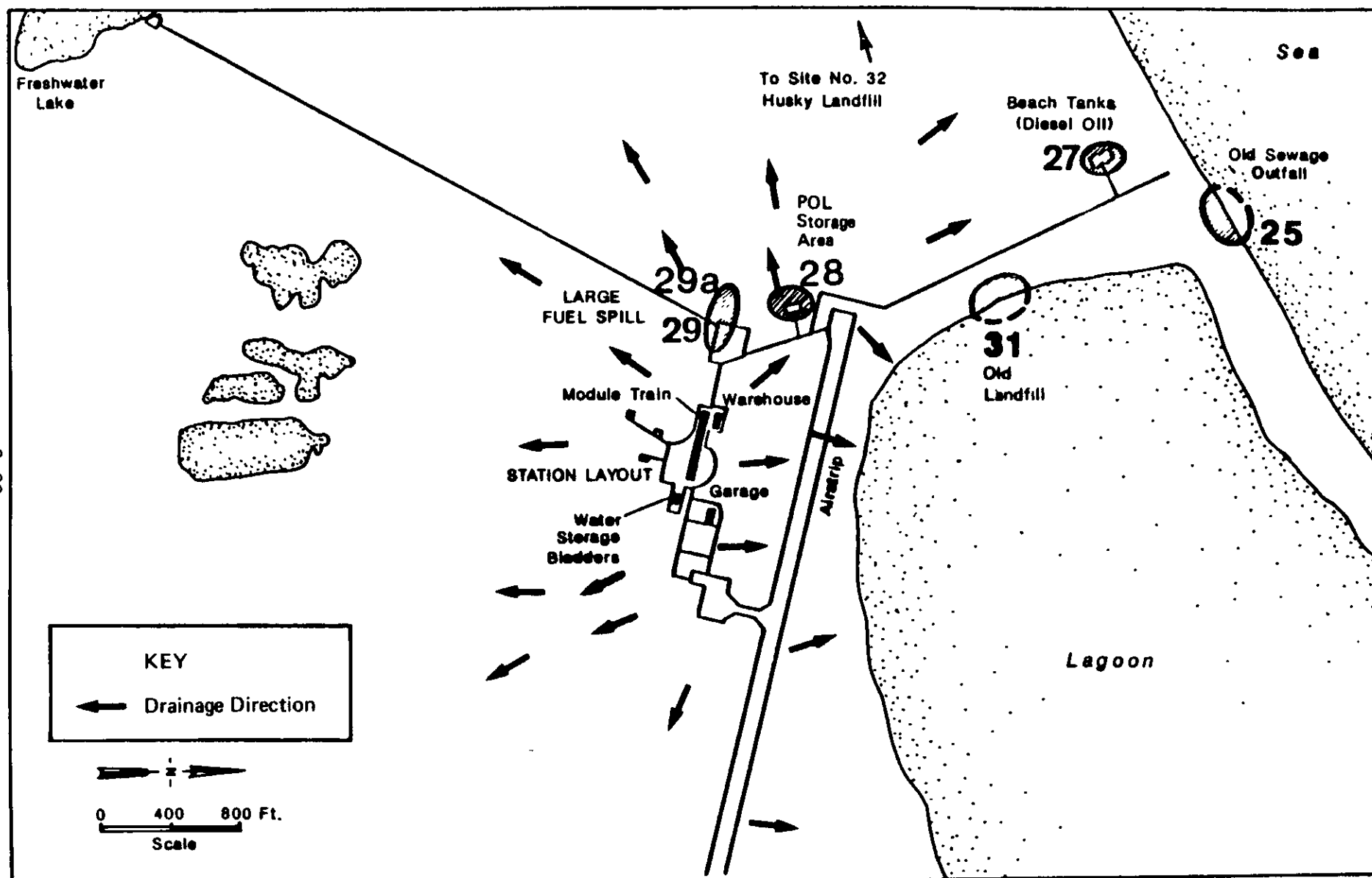


Figure 2-11. SURFACE DRAINAGE POINT LONELY AFS



maximum temperatures in summer are 29°F and 44°F, respectively. In winter, these temperatures are -25°F and -6°F, respectively. Temperature extremes for the period of record (1959 to 1974) were -56°F and 78°F (Selkregg 1974-1976).

2.12.4 Human Resources

POW-1 includes 2830 acres of land located approximately 685 miles north of Anchorage. An average of 17 personnel are currently stationed at POW-1. POW-1 is completely isolated; no human activity exists in the surrounding area on a continuing basis, except for the personnel stationed at POW-1. The U.S. Coast & Geodetic Survey (USC&GS) reported in 1951 that the nearby locality of Kokruagarok was an Eskimo campsite, and that the abandoned village of Kolovik was located approximately 3 miles to the southwest (Figure 1-4).

2.13 PREVIOUS POW-1 IRP ACTIVITIES

The CH2M Hill Phase I Report reviewed and identified three POW-1 sites as having a very high potential for contaminant migration and warranting additional study: the POL Storage Area (Site 28), Old Dump Site (Old Landfill, Site 31) and the Husky Dump Site (Husky Landfill, Site 32). A limited surface water sampling program was proposed for these three sites. The Phase II, Stage 1 Report by Dames & Moore presented the results of this sampling program. The Phase II, Stage 2 Report by Dames & Moore presented the results of additional surface water sampling at these three POW-1 sites.

During the 1987 WCC site visit, the Husky Landfill and POL Storage Area were proposed for additional sampling and investigation. The Old Landfill was reviewed and no further investigation was recommended at that time. The Old Sewage Outfall and Beach Tanks (Sites 25/27) and the Large Fuel Spill (Sites 29/29A) were later proposed for additional sampling and investigation. The 1988 Stage 3 efforts carried out the sampling program

developed during the previous IRP activities and the 1987 WCC site visit (Section 3.4).

2.13.1 CH2M Hill IRP Phase I Report, 1981

At POW-1, the following sites were reviewed and identified as having no potential for migration and were, therefore, not included in the site rating assessment and eliminated from further study:

- Gasoline Storage and Material Storage (Site 23)
- Diesel Fuel Storage (Site 24)
- Drum Storage (Site 26)
- Diesel Fuel Beach Storage Tanks (Site 27)
- Vehicle and Equipment Storage (Site 30).

The following sites were reviewed, rated, and identified as areas that were not considered to pose a significant hazard for migration of contaminants and did not warrant additional study:

- Sewage Disposal Area (Old Sewage Outfall, Site 25)
- Diesel Fuel Spill (Large Fuel Spill, Sites 29/29A).

The following sites were reviewed, rated, and identified as having the highest potential for contaminant migration and, therefore, warranted additional study:

- POL Storage Area (Site 28)
- Old Dump Site (Old Landfill, Site 31)
- Husky Dump Site (Husky Landfill, Site 32).

It was recommended that additional study including a very limited program of surface water sampling be done at Sites 28, 31, and 32.

2.13.2 Dames & Moore IRP Phase II, Stage 1 Report, 1986

The IRP Phase II, Stage 1 field investigation was conducted by Dames & Moore in 1986. One surface water sample per site was analyzed for TOC, TOX, lead, phenols, oil and grease, and PCBs.

2.13.2.1 POL Storage Area (Site 28). Surface water samples collected from the adjacent pond were reported to have elevated concentrations of TOC at 20 mg/L, TOX at 0.17 mg/L, and oil and grease at 7.0 mg/L. Lead, PCBs, and phenols were not tested for in the water samples.

2.13.2.2 Old Dump Site (Old Landfill, Site 31). A water sample obtained from the adjacent saltwater lagoon was reported to have concentrations of TOC at 4.0 mg/L and TOX at 0.95 mg/L. Lead, phenols, and PCBs were reported with concentrations below contract detection limits of 0.01, 0.01, and 0.0005 mg/L, respectively. Oil and grease were not tested for in the water samples.

2.13.2.3 Husky Dump Site (Husky Landfill, Site 32). Water samples from the adjacent pond were reported to have concentrations of TOC at 52 mg/L and TOX at 8.4 mg/L. Lead and PCBs were reported below contract detection limits of 0.01 and 0.0005 mg/L, respectively. Phenols were reported at a concentration of 0.025 mg/L. Oil and grease were not tested in the water sample.

2.13.3 Dames & Moore IRP Phase II, Stage 2 Report, 1987

The Phase II, Stage 2 field investigation by Dames & Moore in 1987 was designed to confirm the presence of contamination within the specified areas of investigation, determine the magnitude of contamination and potential for migration of those contaminants in the environmental media, identify public health and environmental hazards of migrating pollutants, and identify additional investigation required.

At POW-1, surface water samples were collected upgradient and downgradient of Sites 28 and 32, and one surface water sample was collected from Site 31.

The Phase II, Stage 1 analysis in 1986 used the indicator parameters in a screening process as a basis for the Phase II, Stage 2 analysis. The Stage 2 investigation included group analyses for specific compounds. The group parameters for analyses were purgeable halocarbons, phenols, and TPHs. The purgeable halocarbon analyses were done on Sites 28, 31, and 32 samples. The phenol analysis was done on the Site 32 sample only.

2.13.3.1 POL Storage Area (Site 28). The surface water samples collected at Site 28 were tested for purgeable halocarbons and none were detected. TPHs were reported at 1.5 to 2.0 mg/L in the surface water samples.

2.13.3.2 Old Dump Site (Old Landfill, Site 31). The surface water sample was tested for purgeable halocarbons and none were detected. TPHs were not tested for in the sample.

2.13.3.3 Husky Dump Site (Husky Landfill, Site 32). The following purgeable halocarbons and concentrations were reported for surface water samples at Site 32: 1,2-dichloroethane (1.9 to 2.3 $\mu\text{g/L}$), 1,2-dichloropropane (2.7 to 3.8 $\mu\text{g/L}$), and tetrachloroethene (1.1 to 1.4 $\mu\text{g/L}$). Surface water samples were tested for phenols; pentachlorophenol was reported at concentrations from 0.0095 to 0.0096 mg/L.

3.0

FIELD INVESTIGATION PROGRAM

3.1 INTRODUCTION

The Stage 3 IRP field investigations for Barter Island AFS (BAR-M), Bullen Point AFS (POW-3), and Point Lonely AFS (POW-1) were established by the USAF Statement of Work (SOW) Contract No. F33615-D-4544/0008, as modified. The SOW is included as Appendix B of this technical report. The primary emphasis of the field investigations, prescribed in the SOW, was to conduct surface soil and surface water sampling programs for laboratory analyses of potential contaminants at the station sites. In addition, engineering investigations (hydrologic evaluations, landfill erosion control studies, and POL tank inspections) and simple removals were performed at the three DEW Line stations. The DEW Line field investigation chronology is presented on Figure 3-1. The field investigation programs for BAR-M, POW-3, and POW-1 are presented in Sections 3.2, 3.3, and 3.4, respectively.

3.2 BARTER ISLAND AFS (BAR-M)

The field investigation at BAR-M was performed to meet the requirements of the IRP Stage 3 SOW. Five sites identified by the SOW and shown on Drawing No. 1 are the Old Landfill (Site 1), the Sewage Lagoon (Site 2), the POL Catchment Basin (Site 3), the New Landfill (Site 4), and the Contaminated Ditch (Site 8). A sampling program was conducted to collect water and soil samples for laboratory analyses of potential contaminants at the station. The water and soil sampling program is presented in Section 3.2.2. In addition, a hydrologic evaluation of an approximately 50-acre study area

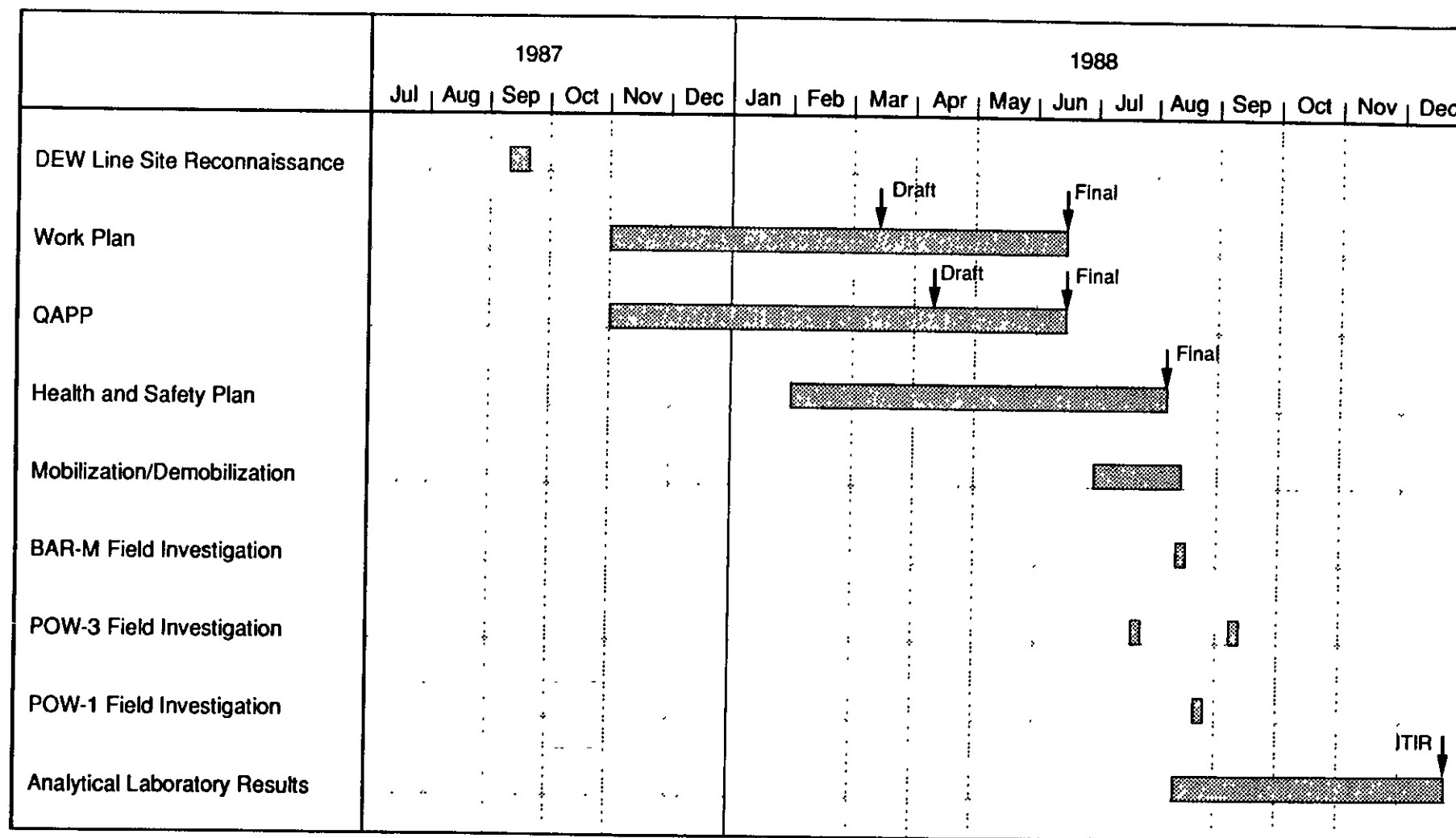


Figure 3-1. DEW LINE FIELD INVESTIGATION CHRONOLOGY

adjacent to the Beaufort Sea and an engineering evaluation for erosion control at the Old Landfill were conducted as part of the field investigation. The hydrologic and engineering evaluations are presented in Sections 3.2.3 and 3.2.4, respectively.

3.2.1 Time Sequence of Work Performed

Field work took place during Summer 1988. The field team of Mr. Kelly Susewind, Task Leader (WCC Anchorage), Mr. Keith Mobley (WCC Anchorage), Mr. James Munter (WCC Anchorage), and Ms. Robin Spencer (WCC Oakland) completed field task activities at BAR-M as described in the SOW. Resumes of the field team members are in Appendix G.

After mobilizing equipment in Anchorage and Oakland, the field team and equipment were flown to Prudhoe Bay by a scheduled commercial carrier on August 16, 1988. A charter service airline then flew the field crew and some of the equipment to Barter Island. A brief orientation of BAR-M was provided by the Station Chief. The remainder of the day was spent reviewing the field conditions and organizing equipment. August 17 was spent locating all sample sites, preparing and labeling sample containers, and calibrating the field instruments. By the end of the day, not all of the field equipment had arrived, due to poor weather conditions. Commercial carrier flight schedules for sample shipments to Denver were confirmed. On August 18 all the soil samples were collected; on August 19 the sites were mapped.

On August 20 the field team conducted the engineering investigation of the Old Landfill and the hydrologic evaluation of the facility. August 21 was spent collecting all the surface water samples. All the samples were packed and shipped to Denver for laboratory analyses, via Prudhoe Bay and Anchorage. Chain-of-custody forms are found in Appendix D. Demobilization from BAR-M was performed on August 22, 1988.

3.2.2 Soil and Surface Water Sampling Program

All of the sample locations for BAR-M were temporarily marked for identification with survey lath. Additionally, each site was surveyed using a tape measure and compass. Photographs of the sample locations were taken. Prior to leaving the site, all of the survey data were compiled and checked for accuracy.

The BAR-M sampling program consisted of water and soil sampling. Water samples were obtained primarily in the established drainage systems and where standing water apparently was contaminated by upstream sources. Surface water samples were also obtained from the Sewage Lagoon. Soil sampling included obtaining samples of sediment associated with the water sampling program.

Table 3-1 presents a list of sample identification numbers and locations for all the soil and water samples collected at BAR-M. Analytical laboratory data summaries are presented in Volume II, Appendix E. Prior to mobilization, all of the sample containers were labeled for sample type, location, and site; and the required preservatives were placed in the containers. After obtaining the sample, the date, time, and sampling personnel were marked on the label.

3.2.3 BAR-M Hydrologic Evaluation

3.2.3.1 Introduction. A hydrologic evaluation was made of an approximately 50-acre area located adjacent to the Beaufort Sea (Drawing No. 1). The two well-defined drainages in the area that discharge to the sea are termed the Contaminated Ditch and the Old Landfill Ditch. A third drainage area investigated in this study lies between the Contaminated Ditch and Old Landfill Ditch drainage areas. The purposes of the hydrologic investigation were to describe the hydrologic environment of the study area including sources, directions, and approximate rates of movement of surface water; characterize the general hydrologic conditions of the area; assess the origins and volumes of flow through the New Landfill; and

Table 3-1. BARTER ISLAND AFS (BAR-M) SOIL AND WATER SAMPLE IDENTIFICATIONS AND SAMPLE LOCATIONS

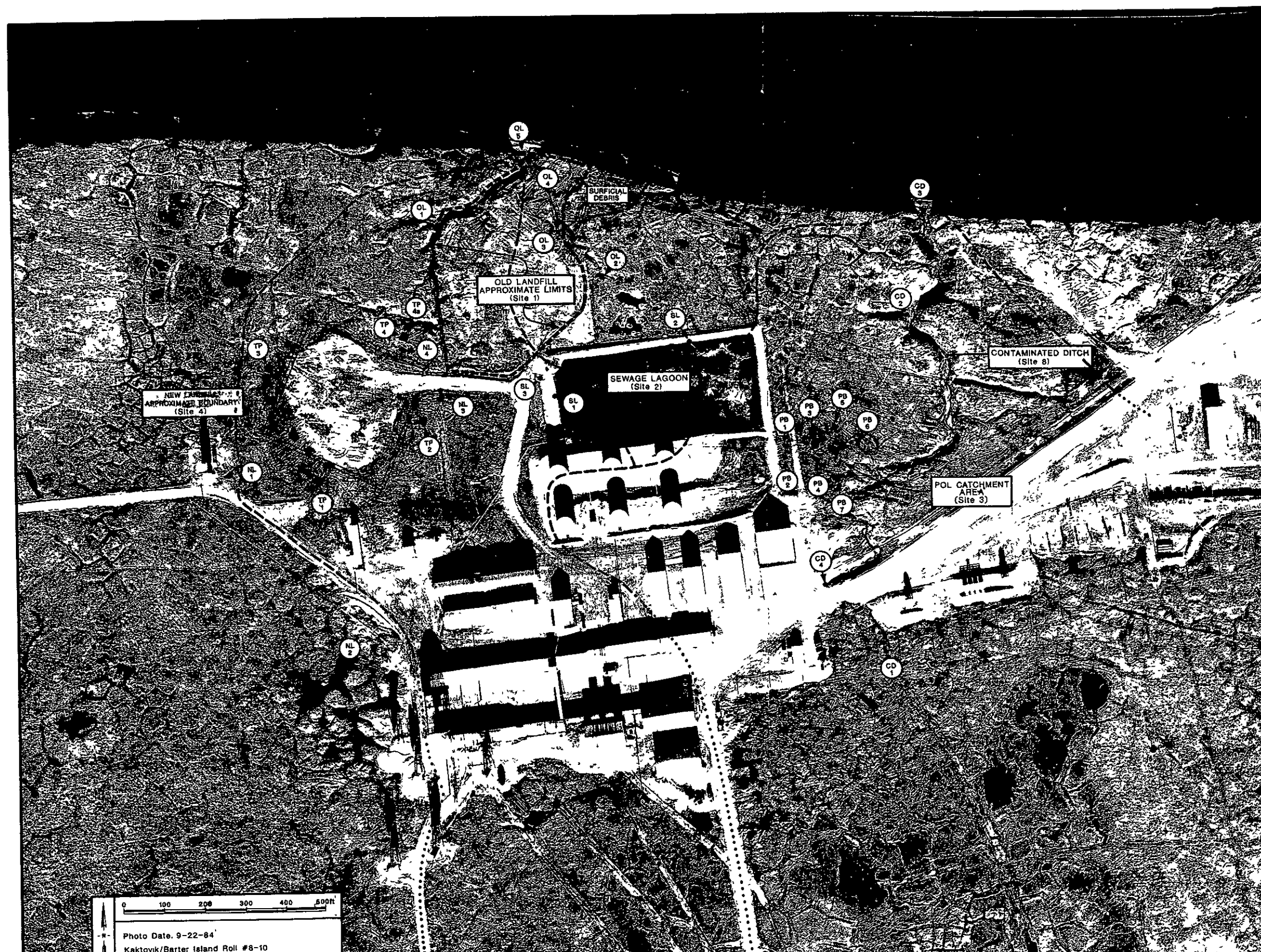
WCC I.D.	Lab I.D.	Sample Description	Sample Location
1042-SO-004-GS-88-0001	001326-0012-SA	Soil, Old Landfill (Site 1)	OL-1
1042-NS-004-GN-88-0002	001340-0001-SA	Aqueous, Old Landfill (Site 1)	OL-1
1042-SO-005-GS-88-0001	001326-0013-SA	Soil, Old Landfill (Site 1)	OL-2
1042-NS-005-GN-88-0002	001344-0007-SA	Aqueous, Old Landfill (Site 1)	OL-2
1042-SO-006-GS-88-0001	001326-0014-SA	Soil, Old Landfill (Site 1)	OL-4
1042-NS-006-GN-88-0002	001344-0022-SA	Aqueous, Old Landfill (Site 1)	OL-4
1042-SO-007-GS-88-0001	001326-0015-SA	Soil, Old Landfill (Site 1)	OL-5
1042-NS-007-GN-88-0002	001344-0008-SA	Aqueous, Old Landfill (Site 1)	OL-5
1042-SO-007-GS-88-0003	001326-0016-SA	Soil, Old Landfill (Site 1)	OL-5
1042-NS-008-GN-88-0001	001340-0002-SA	Aqueous, Old Landfill (Site 1)	OL-3
1042-SO-001-GS-88-0001	001326-0011-SA	Soil, Sewage Lagoon (Site 2)	SL-3
1042-NS-001-GN-88-0002	001340-0004-SA	Aqueous, Sewage Lagoon (Site 2)	SL-3
1042-NS-002-GN-88-0001	001340-0005-SA	Aqueous, Sewage Lagoon (Site 2)	SL-1
1042-NS-003-GN-88-0001	001340-0006-SA	Aqueous, Sewage Lagoon (Site 2)	SL-2
1042-SO-013-GS-88-0001	001326-0001-SA	Soil, POL Catchment Area (Site 3)	PB-1
1042-SO-013-GS-88-0002	001326-0002-SA	Soil, POL Catchment Area (Site 3)	PB-2
1042-NS-013-GN-88-0002	001344-0001-SA	Aqueous, POL Catchment Area (Site 3)	PB-1
1042-SO-014-GS-88-0001	001326-0003-SA	Soil, POL Catchment Area (Site 3)	PB-2
1042-NS-014-GN-88-0002	001344-0002-SA	Aqueous, POL Catchment Area (Site 3)	PB-2
1042-SO-015-GS-88-0001	001326-0004-SA	Soil, POL Catchment Area (Site 3)	PB-3
1042-NS-015-GN-88-0002	001344-0003-SA	Aqueous, POL Catchment Area (Site 3)	PB-3
1042-SO-016-GS-88-0001	001326-0005-SA	Soil, POL Catchment Area (Site 3)	PB-4
1042-SO-017-GS-88-0001	001326-0006-SA	Soil, POL Catchment Area (Site 3)	PB-5
1042-SO-018-GS-88-0001	001326-0007-SA	Soil, POL Catchment Area (Site 3)	PB-6
1042-SO-019-GS-88-0001	001326-0008-SA	Soil, POL Catchment Area (Site 3)	PB-7
1042-SO-009-GS-88-0001	001326-0017-SA	Soil, New Landfill (Site 4)	NL-1
1042-NS-009-GN-88-0002	001344-0012-SA	Aqueous, New Landfill (Site 4)	NL-1
1042-SO-010-GS-88-0001	001326-0018-SA	Soil, New Landfill (Site 4)	NL-2
1042-NS-010-GN-88-0002	001344-0011-SA	Aqueous, New Landfill (Site 4)	NL-2
1042-SO-011-GS-88-0001	001326-0019-SA	Soil, New Landfill (Site 4)	NL-3
1042-NS-011-GN-88-0002	--	Aqueous, New Landfill (Site 4)	NL-3
1042-SO-012-GS-88-0001	001326-0020-SA	Soil, New Landfill (Site 4)	NL-4
1042-NS-012-GN-88-0002	--	Aqueous, New Landfill (Site 4)	NL-4
1042-NS-012-GN-88-0003	--	Aqueous, New Landfill (Site 4)	NL-4
1042-NS-016-GN-88-0002	001344-0004-SA	Aqueous, Contaminated Ditch (Site 8)	CD-4
1042-SO-020-GS-88-0001	001326-0009-SA	Soil, Contaminated Ditch (Site 8)	CD-1
1042-NS-020-GN-88-0002	--	Aqueous, Contaminated Ditch (Site 8)	CD-1
1042-SO-021-GS-88-0001	001326-0010-SA	Aqueous, Contaminated Ditch (Site 8)	CD-2
1042-NS-021-GN-88-0002	--	Soil, Contaminated Ditch (Site 8)	CD-2
1042-NS-021-GN-88-0003	001344-0006-SA	Aqueous, Contaminated Ditch (Site 8)	CD-2
1042-SO-022-GS-88-0001	001326-0021-SA	Soil, Contaminated Ditch (Site 8)	CD-3
1042-NS-022-GN-88-0002	--	Aqueous, Contaminated Ditch (Site 8)	CD-3
Trip Blank	001344-0019-SA	Aqueous, Trip Blank	--
Field Blank	001344-0020-SA	Aqueous, Field Blank	--

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prepare a hydrologic budget for the Sewage Lagoon and describe the possible effects of discharge from the lagoon on other sites in the area.

3.2.3.2 Evaluation Methods. Surface water discharge measurements were made at 30 locations on August 20, 1988 by measuring channel width and depth and estimating the average velocity of flow (Appendix C). Areas of groundwater seepage and unchanneled overland flow were also noted. Shallow trenches were hand excavated at four locations near the New Landfill and hydrologic gradients were measured using a hand-held level and stadia rod. Interviews were conducted with local water and sewer system operators, and water use and sewer system discharge data were copied and evaluated.

3.2.3.3 Hydrologic Setting. The hydrologic investigation was carried out in late Summer 1988 at a time when the active layer above the permafrost was at or near its annual maximum thickness. No significant quantities of precipitation had occurred in the area for at least 3 days prior to the hydrologic study, and visual observations suggested that streamflows were at base flow conditions. Drawing No. 1 shows the location of the three drainage areas in the study area as specified in the SOW. The Old Landfill Ditch drainage was observed to discharge approximately 13 to 19 gallons per minute (gpm) to the sea from a drainage area that includes the New Landfill, part of the Old Landfill, part of the Sewage Lagoon, and some tundra and facility development areas. The Contaminated Ditch drainage was observed to discharge approximately 36 to 67 gpm to the sea from a drainage area encompassing part of the Sewage Lagoon, the POL Catchment Basin, and some tundra and facility development areas. Between the two ditches is a drainage area that includes part of the Sewage Lagoon, some tundra, and part of the Old Landfill. The drainage in this area is not well channelized and a significant percentage of overland flow occurs, making discharge volumes difficult to estimate. The Sewage Lagoon was constructed within all three drainages in the study area.



Legend Soil and Water Sample Locations OL 1 Old Landfill (Site 1) NL 1 New Landfill (Site 4) CD 1 Contaminated Ditch (Site 8) PB 1 POL Catchment Area (Site 3) SL 1 Sewage Lagoon (Site 2) TP 1 Test Pit (Engineering & Hydrology Studies)			Date August 1990 Job No 90275J Designed By KM Drawn By SM Scale 1" = 118' Drawing No 1	
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SOIL AND WATER SAMPLE LOCATIONS BARTER ISLAND AFS (BAR-M)

3.2.3.4 New Landfill. The New Landfill was surrounded mostly by water-saturated tundra with standing or flowing water on all sides except near the southeast corner of the New Landfill, which has the highest elevation. In the area surrounding the New Landfill, the tundra slopes down toward the north at a slope of approximately 0.02 ft/ft. Water from the south, moving through and on the active zone, is partially or completely blocked by the New Landfill berm and the underlying compressed and possibly frozen natural soils. Shallow ditches channel water to the west-northwest along the edge of the New Landfill berm and around the southwest corner of the New Landfill. Flow near the southwest corner of the New Landfill is augmented by some overland flow from the south-southwest. As the water continues flowing northward on the west side of the New Landfill, it moves as unchannelized overland flow from the northwest corner of the New Landfill to an east-west trending ravine that is a tributary to the Old Landfill Ditch. The total flow being diverted around the New Landfill was estimated to be 4-5 gpm.

A very minor amount of seepage was observed to emanate from the tundra and from the southeast side of the New Landfill. This water moved northward, through a culvert under the access road to the New Landfill, and into the Old Landfill Ditch.

Potentially contaminated seepage emanates from the north berm of the New Landfill. This seepage collects in small channels and discharges to the east-west trending ravine. The cumulative volume of flow out of the north berm was estimated at 2 gpm.

3.2.3.4.1 Groundwater Flow. Test pits were hand dug on each side of the New Landfill to characterize subsurface conditions. Permafrost was found to occur at depths ranging from 0.7 to 1.8 feet and soils above that depth were found to be saturated and composed mainly of fine sand and silt, and organic matter (Table 3-2 and Figure 3-2). Groundwater seepage out of the tundra and natural soils was observed to occur upgradient (south) of

Table 3-2. BAR-M TEST PIT LOGS NEAR THE NEW LANDFILL (SITE 4)

TEST PIT 1

<u>Depth (inches)</u>	<u>Description</u>
0-2	Live organic mat with occasional gravel
2-3	Organic mat, brown with macropore water flow
3-15	Fine sand, with organics, saturated
15-22	Fine sand, gray, with trace silt, slow water infiltration
22	Gray fine sand with trace silt, frozen with no visible ice

TEST PIT 2

<u>Depth (inches)</u>	<u>Description</u>
0-1	Live organic mat with some gravel, saturated
1-3	Sandy organics, brown-gray, with occasional gravel, saturated
3-5	Organic mat, dark brown, with macropore flow
5-16	Fine sand, gray, with very occasional gravel, saturated
16-22	Organic mat, dark brown, with Macropore flow
22	Clear ice

TEST PIT 3

<u>Depth (inches)</u>	<u>Description</u>
0-4	Live vegetative mat, waterflow into pit
4-14	Peat with some live roots, ice not visible, water inflow
14	Frozen peat

TEST PIT 4

<u>Depth (inches)</u>	<u>Description</u>
0-8	Vegetative mat, slow water infiltration
8	Organic mat, frozen, 50 percent ice

TEST PIT 4a (located 6 feet north from Test Pit 4)

<u>Depth (inches)</u>	<u>Description</u>
0-9	Vegetative mat
9	Silt, brown, frozen, no visible ice

Note: See Drawing No. 1 for test pit locations.

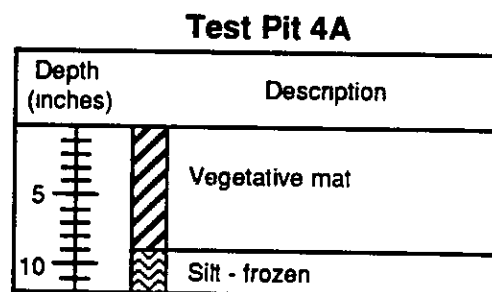
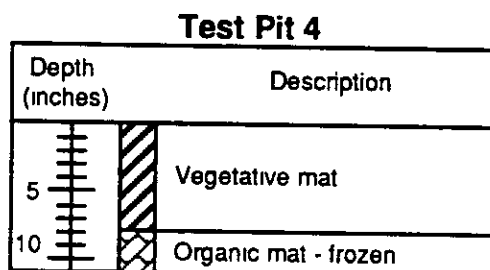
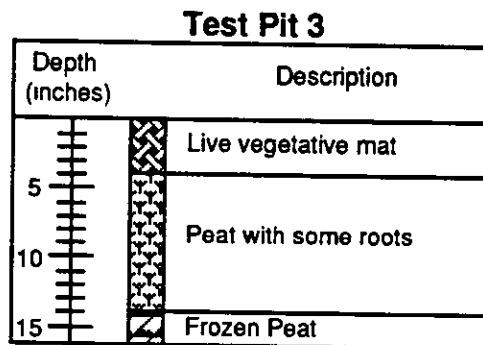
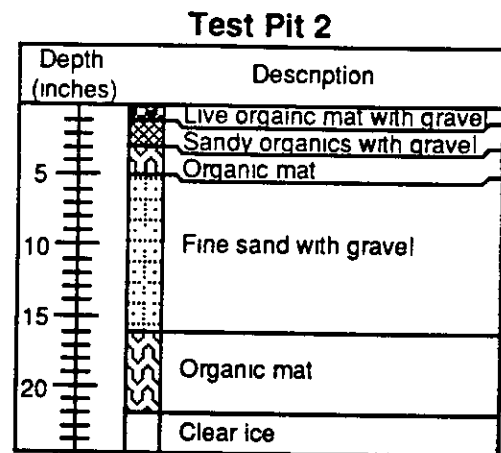
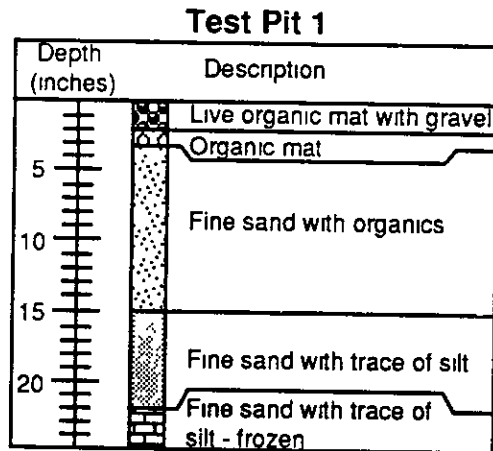


Figure 3-2 BAR-M TEST PIT LOGS NEAR NEW LANDFILL (SITE 4)

the landfill berms and collect into drainages flowing parallel to the berms. Although groundwater flow occurs through thawed soils with a gradient equal to the land surface slope (approximately 0.02 ft/ft), waterflow in many areas of saturated soil appeared to occur mainly as overland flow through the porous and highly permeable surface organic mat.

3.2.3.4.2 Origin of Leachate on the North Side of the New Landfill.

The leachate observed to emanate from the gravel berm on the north side of the New Landfill must originate either from direct precipitation onto the surface of the New Landfill, from the surface and subsurface water sources on the south side of the New Landfill, or some combination of the two. Average precipitation at Barter Island during June, July, and August (the primary period that precipitation occurs as rainfall) averages 2.56 inches, or 41 percent of the average annual total of 6.28 inches (NOAA 1987, 1988). This precipitation would be expected to rapidly infiltrate the gravel surface of the New Landfill as a result of its flat, permeable surface and bermed edges. Water from snowmelt was not considered to significantly contribute to the infiltration, since the snow on top of the New Landfill melts early during the summer thaw and much of it would probably run off the still frozen landfill cover. Evapotranspiration of precipitated water is expected to be minimal as a result of the cool, humid climate and lack of vegetation. The New Landfill is approximately 350 feet long in the downgradient (south to north) direction. The northern edge of the New Landfill is approximately 7 feet lower than the southern edge, since it was constructed on the natural gradient. This being the case, it is assumed that all of the water entering the New Landfill as precipitation would seep out of the north berm during the 100-day thaw period each year. The average flow would be expected to be 1400 gallons/day (0.97 gpm). This is approximately half of the estimated cumulative flow rate from the north side of the New Landfill observed on August 20, 1988, but indicates that a substantial percentage of leachate may originate as precipitation on the gravelled landfill surface. If the assumption on snowmelt is incorrect, and a significant percentage does infiltrate into the landfill, then all of the seepage from the north berm could originate as precipitation.

Field observations indicate that shallow groundwater flow from upgradient tundra sources may not be a major contributor to leachate generation. The obvious surfacing of water from the tundra on the south side of the New Landfill indicates that the landfill acts as at least a partial dam to waterflow. This could be a result of the low permeability of the compressed soils underlying the landfill berm, the possible frozen state of underlying compressed soils, the presence of a groundwater or permafrost mound within the New Landfill, or some combination of these factors.

3.2.3.5 Sewage Lagoon. The Sewage Lagoon receives inflows from direct precipitation onto its surface, discharge from the BAR-M package sewage treatment plant, periodic (almost daily) dumping of sewage from a tanker truck from the village of Kaktovik, and summertime disposal of the liquids from 55-gallon drums of sewage ("honey buckets") from Kaktovik. Fluids leave the Sewage Lagoon by evaporation and seepage through the gravel berm surrounding the lagoon into the drainages of the Old Landfill Ditch, the Contaminated Ditch, and the tundra area between the two ditches. Assuming annual flow equilibrium, estimates of annual quantities for each of these components are given in Table 3-3. Seepages from the lagoon were calculated as a residual from estimates of the other quantities. Assuming that these seepages occur during a 100-day thaw period each year, average total seepage outflows from the Sewage Lagoon would be about 8.5 gpm.

The largest apparent source of Sewage Lagoon leakage occurs in the northwest corner of the lagoon near an exposed culvert. Although the culvert itself did not transmit fluids, a seepage face beneath the culvert was leaking at an estimated rate of 0.9 gpm. The seepage face appeared to be eroding at a slow rate as a result of the continuous seepage. This process could accelerate in the future and lead to substantially greater leakage rates. The total flow in the three drainage areas receiving seepage from the Sewage Lagoon and attributable to leakage from the lagoon

Table 3-3. BAR-M SEWAGE LAGOON ANNUAL FLUID BUDGET

<u>Inflows</u>	<u>Quantity (gallons)</u>
Treated sewage, Bar-M package treatment plant, 1987	957,330
Hauled sewage via tankers from Kaktovik (estimated 600 gallons/week)	312,000
Honey buckets from Kaktovik (850 drums x 50 gallons liquid/drum)	42,500
Precipitation (annual average 6.28 inches/year)	<u>461,000</u>
Total Inflows	1,773,000
<u>Outflows</u>	
Pan Evaporation (annual average = 7.44 inches/year [NOAA 1987-1988])	548,000
Leakage (Total Inflows - Potential Evaporation)	1,225,000

was estimated to be about 4 to 6 gpm during the site visit on August 20, 1988. The annual fluid budget for the Sewage Lagoon illustrates that most inputs to the lagoon occur between October and May, when seepage is minimal or absent. The accumulated volume of sewage and treated effluent during this time period equates to approximately 1 foot of liquid over the area of the lagoon. Thus, fluid levels in the lagoon and seepage rates from the lagoon are likely to be highest immediately following the annual spring/early summer thaw.

3.2.3.6 Hydrological Relationships and Sources of Contamination. The drainage area of the Old Landfill Ditch contains the Old Landfill, the New Landfill, part of the Sewage Lagoon, and some tundra and facility development areas. Discharge from the west side of the Sewage Lagoon flows west adjacent to the south side of the Old Landfill in a deeply incised channel, but probably does not contribute to flow through the Old Landfill because of the likely occurrence of permafrost in the Old Landfill at a level higher than the level of the stream. The average summertime flows in the Old Landfill Ditch are probably increased by about 10 percent compared to predevelopment conditions as a result of the Sewage Lagoon usage. These increased flows, in turn, may contribute to active erosion of the ditch sidewalls during the summer months. Similarly, Sewage Lagoon effluent from the east side of the lagoon may contribute to active erosion occurring in the lower reaches of the Contaminated Ditch and an east-west trending tributary located east of the northeast corner of the lagoon.

Considering the drainage area immediately north of the Sewage Lagoon, some of the discharge from the north side of the lagoon collects into a small stream that flows directly over the Old Landfill deposits. At the bluff line, the stream forms a small waterfall to the beach of the Beaufort Sea. This stream also receives a small amount of flow from seepages emanating from the Old Landfill deposits above the bluff line. Although rates of flow and erosion were fairly low on August 20, 1988, the location of this stream directly on Old Landfill deposits may lead to active erosion

49 and gully formation at the bluff line in the future. The relative position of the Sewage Lagoon, the seepages from the Old Landfill, and the small stream in this drainage area make it unlikely that the Sewage Lagoon is the source of leachate from the Old Landfill. As with the New Landfill, the leachate from the Old Landfill probably originates as precipitation.

3.2.3.7 BAR-M Site Hydrology - Summary and Conclusions. Numerous streams occur in the BAR-M area that have measurable flow during late summer base flow conditions. The streams are fed by numerous shallow groundwater discharge areas and areas of diffuse overland flow through tundra vegetation. Thawed soils are typically thin (less than 2 feet) and composed of organic material with low to high porosity and permeability, and fine-grained sands and silts with relatively low permeability. In several areas, most water is transported through the vegetative mat as overland flow, particularly during higher flow conditions.

Visibly contaminated leachate emanating from the north berm of the New Landfill probably originates mainly as precipitation on the surface of the landfill. Field observations support a conceptual model where a groundwater or permafrost mound exists in the New Landfill, created by local recharge from precipitation and relatively low-permeability (possibly frozen) landfill or compacted tundra deposits.

Annual fluid flows through the Sewage Lagoon are approximately 1.77 million gallons. Approximately 69 percent of this amount (1.22 million gallons) leaks out of the lagoon through gravel berms during the annual thaw period. This leakage discharges into three different drainage areas. Leakage from the Sewage Lagoon flows on the south and west sides and across the top of the Old Landfill.

Initial Remedial Measures (IRMs) resulting from the hydrologic evaluation of BAR-M are presented in Section 5.2 of this technical report.

3.2.4 Engineering Evaluation for Erosion Control at BAR-M Old Landfill (Site 1)

3.2.4.1 Introduction. An engineering study was conducted in the vicinity of the Old Landfill to evaluate alternatives for mitigating erosion problems on the west and north sides of the Old Landfill. The field study was conducted on August 18, 1988. Drawing No. 1 shows the plan view of the Old Landfill in relation to the Beaufort Sea and local drainages where erosion is exposing landfill debris.

3.2.4.2 Technical Background. Erosion processes on the arctic coastal plain and beach erosion adjacent to the Beaufort Sea are governed primarily by thermal changes occurring in the soil mass. Beach erosion rates have been studied and measured by several investigators (Harper 1978). Bluff retreat rates on the order of 1 to 10 meters/year have been observed. One of the major controlling factors for bluff retreat appears to be bluff height, with the highest erosion rates associated with areas of low bluffs. At Barter Island a bluff retreat rate of approximately 1 m/yr is anticipated because the bluff is relatively high. An effort was made to check this rate with the following measurements and line of reasoning: Sediment is removed from the base of the bluff by east to west long shore currents; therefore, the Old Landfill (particularly when it extended approximately 40 meters further north into the Beaufort Sea) provided protection for the shoreline west of the Landfill. If the straight shoreline west of the Old Landfill is projected to the east, it lies approximately 35 meters offshore in the vicinity of the Contaminated Ditch. Assuming that this much bluff retreat has taken place since the Old Landfill was emplaced approximately 30 years ago, a bluff retreat rate of 1.1 meter/year is obtained. This estimate appears reasonable because examination of USAF Map 1.A of the BAR-M facility, which was developed in 1962, indicates that the shoreline east and west of the Old Landfill was relatively straight. The Old Landfill protruded north of this line. The reasoning is obviously subject to some error, but certainly suggests that a 1-meter/year bluff retreat is probable for Barter Island.

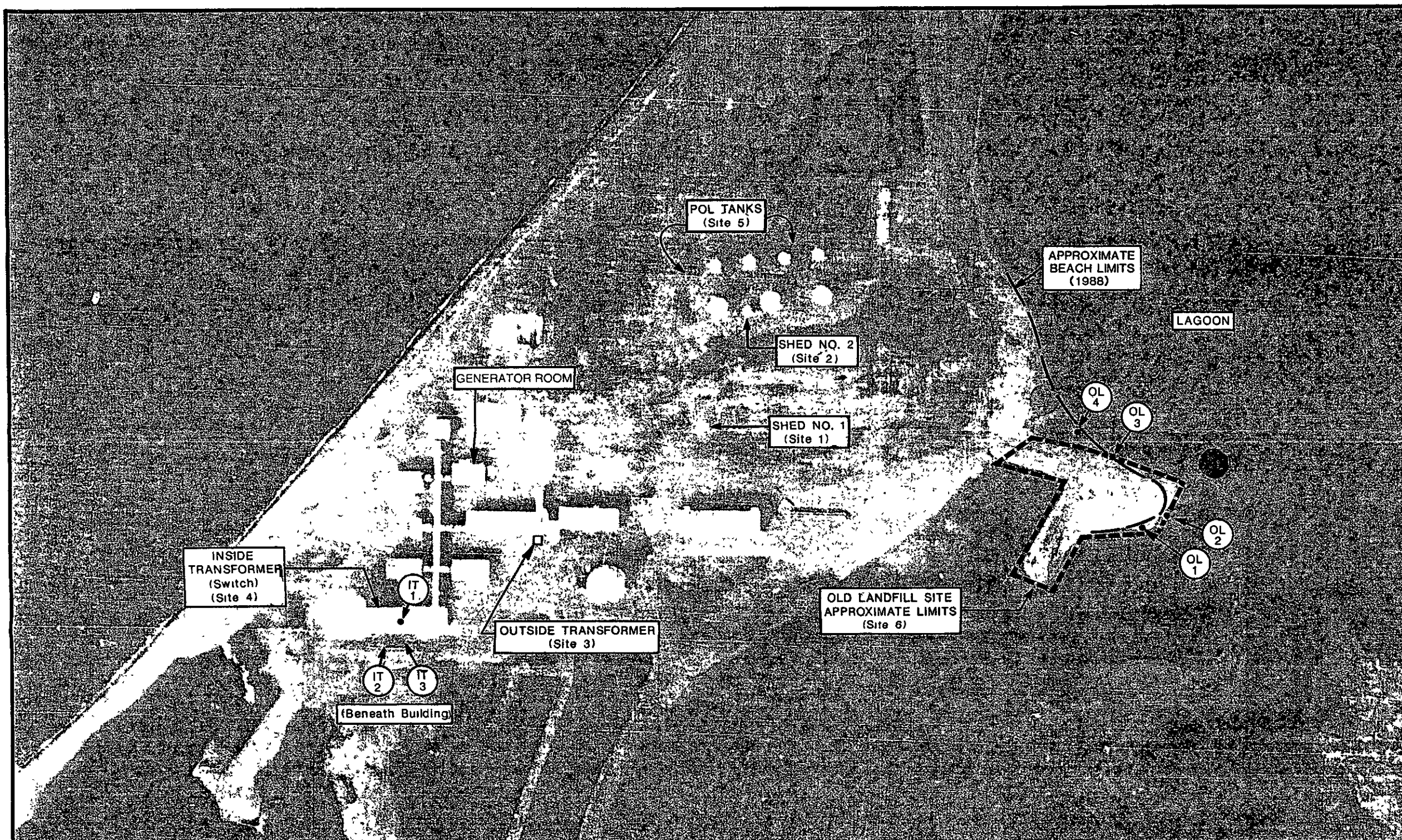
The erosion mechanism starts by thawing a frozen bluff face composed of ice and unconsolidated sediments, which then collapses onto a beach or into a stream where the water removes the loose sediments. As the sediments are removed the bluff face is again exposed, allowing the process to repeat. In a very low energy environment (small stream), near equilibrium can be reached where the sediments will maintain a stable slope near the stream because only small amounts of sediment can be transported. In a high energy environment such as the shore of the Beaufort Sea, the process repeats itself for long time periods.

3.2.4.3 Field Assessment. Stream, ocean wave, and ice erosion have all affected the Old Landfill site. That portion of the landfill which had protruded approximately 40 meters into the Beaufort Sea was reportedly hauled back onto the main part of the landfill, compacted, and covered in 1979 (CH2M Hill 1981). This created a relatively natural looking beach line. However, as the bluffs along the beach retreated from natural coastal processes, landfill debris was again released into the environment. At present it appears that erosion and slope movements may have approached equilibrium along the small stream in the west portion of the Old Landfill. Ocean erosion on the north side of the Old Landfill will continue as the bluffs retreat.

IRMs, to prevent the continuing release of landfill material to the environment, are discussed in Section 5.2 of this technical report.

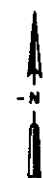
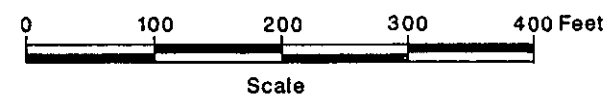
3.3 BULLEN POINT AFS (POW-3)

The field investigation at POW-3 was performed to meet the requirements of the IRP Stage 3 SOW. Six sites identified by the SOW and shown on Drawing No. 2 are Shed No. 1 (Site 1), Shed No. 2 (Site 2), Outside Transformer (Site 3), Inside Transformer (Site 4), POL Tanks (Site 5), and Old Landfill (Site 6). A sampling program was conducted to collect water and soil samples for laboratory analyses of potential contaminants at the



Legend: Soil and Water Sample Locations

- OL 1 Old Landfill (Site 6)
- IT 1 Inside Transformer (Site 4)



Date: August 1990

Designed By: JK

Job No.: 90275J

Drawn By: SM

Scale: 1" = 100'

Drawing No. 2

Photo Date: 8-26-83

Bullen Point Roll #83-12C Picture 4-4

SOIL AND WATER SAMPLE LOCATIONS BULLEN POINT AFS (POW-3)

station. The water and soil sampling program is presented in Section 3.3.2. A simple removals program was performed to remove suspected hazardous materials from Sites 1, 2, and 4; and the Generator Room (no site number because subsequently added to the SOW). In addition, the POL Tanks were visually inspected to assess their physical condition and potential liquid levels. Simple removals and tank inspections are discussed in Sections 3.3.3 and 3.3.4, respectively.

3.3.1 Time Sequence of Work Performed

Field work took place during Summer 1988. The field team of Mr. Chris Vais, Task Leader (WCC, Oakland), Mr. Frederick Wehrenberg (WCC, Oakland), and Mr. Stacey Brown (WCC, Oakland) completed field task activities at POW-3 as described in the SOW. Resumes of the field team members are in Appendix G.

Mr. Fred Wehrenberg performed a "pre-simple removals" trip on July 21-23, 1988. He flew to Prudhoe Bay on a scheduled commercial carrier and then chartered a helicopter to POW-3 for the "pre-simple removals" investigation. An inventory was made of the hazardous materials to be removed from the station during the simple removals program scheduled for late September 1988.

After mobilizing equipment in Anchorage and Oakland for the simple removals program, the field team and equipment were flown to Prudhoe Bay by a scheduled commercial carrier on September 11, 1988. A barge was chartered from VRCA Environmental for 36 hours. The VRCA barge transported the field team and removals equipment to POW-3. Prior to their arrival, the field team organized and pre-calibrated the equipment, and labeled sample containers. The field investigation (water and soil sampling program, tank inspections, and simple removals) was conducted in less than 18 hours on September 13, 1988. All samples were packed on ice and prepared for shipment to a Denver analytical laboratory. When the barge returned to Prudhoe Bay, the samples were transferred to the scheduled commercial carrier for a direct flight to Denver. Chain-of-custody forms

are presented in Appendix D. See Section 3.3.4.2 for information regarding hazardous waste transportation and disposal.

3.3.2 Soil and Water Sampling Program

All of the sample locations for POW-3 were surveyed using a tape measure and compass. Prior to leaving the site, all of the survey data were compiled and checked for accuracy.

The POW-3 sampling program consisted primarily of collecting soil samples at the Old Landfill (Site 6) and beneath the Module Train that housed the Inside Transformer (Site 4). A few water samples were collected at the Old Landfill site. One waste oil sample was collected from the transformer at Site 4.

Table 3-4 presents a list of sample identification numbers and locations for all the soil and water samples collected at POW-3. Analytical laboratory data summaries are presented in Volume II, Appendix E. Prior to mobilization, all of the sample containers were labeled for sample type, location, and site; and the required preservatives were placed in the containers. After collecting the sample, the date, time, and sampling personnel were marked on the label.

3.3.3 Simple Removals

3.3.3.1 Purpose and Scope. The purpose of the simple removals was to remove suspected hazardous materials from POW-3 that may have represented an immediate threat to human health and the environment at the abandoned facility. The scope of the simple removals included identification, testing, overpacking, and shipment off site of suspected hazardous materials--typically containers of petroleum hydrocarbon oils and transformers or switches filled with suspected PCBs liquids. Five drums of oil and waste oil, a large switch suspected of containing PCBs-contaminated liquids, various containers in the flammable liquid storage shed, and an oily liquid on the floor of the pump shed were removed from the site.

Table 3-4. BULLEN POINT AFS (POW-3) SOIL AND WATER SAMPLE IDENTIFICATIONS AND SAMPLE LOCATIONS

WCC I.D.	Lab I.D.	Matrix	Sample Location
1062-NS-009-GN-88-0001	002374-0001-SA	Waste, Inside Transformer (Site 4)	IT-1
1062-NS-007-GS-88-0001	001712-0005-SA	Soil, Inside Transformer (Site 4)	IT-2
1062-NS-008-GS-88-0001	001712-0006-SA	Soil, Inside Transformer (Site 4)	IT-3
1062-NS-001-GN-88-0001	001712-0010-SA	Aqueous, Old Landfill (Site 6)	OL-1
1062-NS-003-GS-88-0001	001712-0012-SA	Soil, Old Landfill (Site 6)	OL-1
1062-NS-004-GS-88-0001	001712-0013-SA	Soil, Old Landfill (Site 6)	OL-2
1062-NS-002-GN-88-0001	001712-0011-SA	Aqueous, Old Landfill (Site 6)	OL-3
1062-NS-002-GN-88-0002	001712-0001-SA	Aqueous, Old Landfill (Site 6)	OL-3
1062-NS-005-GS-88-0001	001712-0002-SA	Soil, Old Landfill (Site 6)	OL-3
1062-NS-006-GS-88-0001	001712-0003-SA	Soil, Old Landfill (Site 6)	OL-4
1062-NS-006-GS-88-0002	001712-0004-SA	Soil, Old Landfill (Site 6)	OL-4
1062-NS-010-GN-88-0001	001712-0008-SA	Aqueous, Trip Blank	--
1062-NS-011-GN-88-0001	001712-0009-SA	Aqueous, Ambient Cond. Blank	--

3.3.3.2 Field Work. Field work was conducted during late September 1988. VRCA Environmental was contracted to transport the WCC removal team and equipment to the Bullen Point AFS via barge, and to provide support during the field program. Hazardous materials were barged by VRCA to Prudhoe Bay and shipped via truck by Glean, Inc. to Defense Reutilization and Marketing Office (DRMO), Elmendorf AFB, for disposal. The Uniform Hazardous Waste Manifest and DD Forms 1348-1 that accompanied the hazardous waste to DRMO are presented in Appendix D.

3.3.3.2.1 Shed No. 1 (Site 1). Shed No. 1, the flammable liquid storage shed, contained numerous small containers of oil, paint thinner, and di-electric fluid. The majority of the containers were empty. The containers found with liquid were divided into three groups: heavy oils (lube oil), light oils and solvents, and di-electric fluid (PCBs oil). The liquids from each group were consolidated into one drum for a total of three drums. The di-electric fluid was tested with the McGraw Edison PCBs Field Test Kit and was assessed to contain >500 ppm. The container of di-electric fluid (DOT spec 5, 5-gallon pail) was labeled as containing PCBs. The DOT spec 17E 55-gallon drum of light oil was labeled as waste, flammable liquid. The DOT spec 17E 55-gallon drum of heavy oil was labeled as waste combustible liquid. All of the small empty containers were crushed and placed in DOT spec 17H drums with "Floor Dry," a clay absorbent material. PCBs-contaminated containers were segregated, overpacked, and labeled for disposal.

3.3.3.2.2 Shed No. 2 (Site 2). Shed No. 2, the pump shed, located near the POL Storage Tanks, contained approximately 8 inches of water on the concrete floor with about 0.5 inch of oil on the surface. The oil was attributed to a punctured 5-gallon lube oil container laying on its side in the shed. The water is suspected to be from rain since the door to the shed was open.

The upper portion of the water was frozen and was removed as ice with a shovel into a DOT spec 17H 55-gallon drum. Residual oil was soaked up using oil-absorbent pads that were also drummed. The water remaining on the floor was then absorbed using "Floor Dry" and was placed into the drum. The drum was labeled as solidified oily water. The door to the shed was closed to prevent rainwater from accumulating inside the shed.

3.3.3.2.3 Outside Transformer (Site 3). The Outside Transformer was investigated and found to be a nitrogen-filled transformer. Therefore, it was neither drained nor removed.

3.3.3.2.4 Inside Transformer (Site 4). The Inside Transformer was identified as a switch and not a transformer. The switch was a liquid bath type and contained <50 mg/kg PCBs based on the McGraw-Edison Field Test Kit procedure performed by WCC personnel. Fifty mg/kg is the detection limit of the PCBs field test kit. The switch was too tall to fit into a 55-gallon drum and had to be disassembled. After it was disassembled, the switch oil was transferred into a DOT spec 5, 5-gallon pail. The switch was placed into two DOT spec 17H 55-gallon drums and cushioned with "Floor Dry", a clay absorbent material. The drums were labeled as containing PCBs.

The floor of the room where the switch was located was heavily coated with the suspect PCBs oil. Floor Dry was applied in an effort to absorb the oil and many of the floor tiles were subsequently removed and placed into a DOT spec 17H 55-gallon drum. Drums of Floor Dry and floor tiles were labeled as containing PCBs. The room was then sealed by nailing plywood over the doors and windows. Signs stating "Danger, Keep Out" and "Poison" were posted on the sealed doors and windows to warn the public from entering this section of the building. The "Poison" signs were used in place of "PCBs" signs because the universal skull and cross bones picture would be better understood by non-English speaking persons.

3.3.3.2.5 Generator Room (No Site Number Assigned). Five 55-gallon drums of oil were found inside the building in the two main generator rooms. All five drums were in deteriorated condition. Three of these drums had never been opened and contained new HDO 30 lube oil. The remaining two drums contained waste lube oil. The two drums of waste lube oil were overpacked into 85-gallon recovery drums. The contents of the three drums of unused lube oil were pumped into new DOT spec 17E drums. The two recovery and the three empty DOT drums were removed from the site.

3.3.3.3 Summary of Simple Removals. Containers of suspected hazardous waste from the simple removals field program were collected, placed into containers, and labeled at the POW-3 sites as detailed above. The barrels were transported by barge to Prudhoe Bay, then by truck to DRMO Anchorage, Elmendorf AFB, for disposal. A total of 12 containers were received at DRMO Anchorage according to the DRMO Anchorage Uniform Hazardous Waste Manifest Document 00188 (Appendix D).

3.3.4 POL Tanks Inspections

Seven large diesel fuel storage tanks were visually inspected during the field program. The surfaces of the tanks are badly deteriorated and rusted, to a greater degree on their seaward side. The POL tanks are secured to concrete pads by bottom support angle brackets that show signs of corrosion. Surface soils adjacent to the concrete pad appeared to be stained by the rusting.

It was difficult to assess the quantity of diesel fuel remaining in the tanks. The bolt-down hatches on the tanks were not removed for interior tank inspection due to the hazardous conditions of the access ladders. The liquid level gages appeared to be inoperable due to substantial corrosion. Measurement readings indicated less than 4-6 inches of product remain in each of the tanks. Typically, aboveground tanks are designed so that the suction pipe lines will not completely drain the tank. This design minimizes sucking up tank bottom contents that may contain sludge and water. It was not reported in references reviewed by WCC if the

decommissioned tanks were thoroughly cleaned immediately before the time POW-3 was abandoned in 1971. Based on the above information, it is reasonable to expect that tank bottom material (i.e. sludge, water, etc.) and fuel may remain in the POL tanks.

3.4 POINT LONELY AFS (POW-1)

The field investigation at POW-1 was performed to meet the requirements of the IRP Stage 3 SOW. Five sites identified by the SOW and shown on Drawing No. 3 are Old Sewage Outfall and Beach Tanks (Sites 25/27), POL Storage Area (Site 28), Large Fuel Spill (Sites 29/29A), Old Landfill (Site 31), and Husky Landfill (Site 32). A sampling program was conducted to collect water and soil samples for laboratory analyses of potential contaminants at the station. The water and soil sampling program is presented in Section 3.4.2. A hydrology study of the Husky Landfill and vicinity was conducted to assess the sources and volume of waterflow through the landfill. The hydrology study is presented in Section 3.4.3.

3.4.1 Time Sequence of Work Performed

Field work took place during Summer 1988. The field team of Mr. Kelly Susewind, Task Leader (WCC, Anchorage), Mr. Keith Mobley (WCC, Anchorage), and Ms. Robin Spencer (WCC, Oakland) completed field task activities at POW-3 as described in the SOW. Resumes of the field team members are in Appendix G.

Arrival and mobilization at Point Lonely occurred on August 22, 1988. Poor flying conditions postponed the arrival of equipment until late evening, August 23. The 23rd was spent reviewing the site and choosing sample locations. On August 24th, Mr. Mobley completed the hydrology study of the Husky Landfill while Mr. Susewind and Ms. Spencer collected surface water and soil samples. August 25th was spent sampling the remaining sites near the DEW Line station and packing and labeling soil and water samples for shipment to Prudhoe and Denver. On August 26 the site and sample locations were mapped and all measurements checked for consistency. Poor weather conditions on August 27 hampered demobilization.

3.4.2. Soil and Water Sampling Program

All of the sample locations at POW-1 were temporarily marked with survey lath for identification during the study. Each site was surveyed using a tape measure and compass. Photographs of the sample locations were taken. Prior to leaving the site, all of the survey data were compiled and checked for accuracy.

The POW-1 sampling program consisted of water and sediment sampling. Water samples were obtained primarily in the established drainage systems and where standing water apparently was contaminated by upstream sources. Soil sampling included obtaining samples of sediment associated with the water sample locations.

Table 3-5 presents a list of sample identification numbers and locations for all soil and water samples collected at POW-1. Analytical laboratory data summaries are presented in Volume II, Appendix E. Prior to mobilization, all of the sample containers were labelled for sample type, location, and site; and required preservatives placed in the containers. After collecting the sample, the date, time, and sampling personnel were marked on the label.

3.4.3 POW-1 Husky Landfill Hydrology Study

3.4.3.1 Purpose and Scope. A hydrology study was conducted in the vicinity of the Husky Landfill to assess the sources and volume of waterflow through the landfill.

3.4.3.2 Field Work. The field study was conducted on August 24, 1988. Drawing No. 3 shows the Husky Landfill and drainage patterns. The landfill is located immediately to the west side of the Husky construction pad and is about 4 feet deep including the gravel cover. Immediately west of the landfill is a low-lying tidal area. A large portion of the landfill surface is currently being used as a staging/storage pad for equipment, piping, and sleds.

Table 3-5. POINT LONELY AFS (POW-1) SOIL AND WATER SAMPLE IDENTIFICATIONS AND SAMPLE LOCATIONS

WCC I.D.	Lab I.D.	Sample Description	Sample Location
1060-SO-013-GS-88-01	001403-0011-SA	Soil, Old Sewage Outfall (Site 25)	SO-1
1060-NS-026-GS-88-01	001403-0025-SA	Aqueous, Old Sewage Outfall (Site 25)	SO-1
1060-SO-014-GS-88-01	001403-0012-SA	Soil, Old Sewage Outfall (Site 25)	SO-2
1060-SO-015-GS-88-01	001403-0013-SA	Soil, Old Sewage Outfall (Site 25)	SO-3
1060-SO-016-GS-88-01	001403-0014-SA	Soil, POL Storage (Site 28)	PS-1
1060-SO-017-GS-88-01	001403-0015-SA	Soil, POL Storage (Site 28)	PS-2
1060-SO-018-GS-88-01	001403-0016-SA	Soil, POL Storage (Site 28)	PS-3
1060-SO-018-GS-88-02	001403-0017-SA	Soil, POL Storage (Site 28)	PS-3
1060-SO-019-GS-88-01	001403-0018-SA	Soil, POL Storage (Site 28)	PS-4
1060-SO-020-GS-88-01	001403-0019-SA	Soil, POL Storage (Site 28)	PS-5
1060-NS-023-GS-88-01	001403-0022-SA	Aqueous, POL Storage (Site 28)	PS-6
1060-SO-022-GS-88-01	001403-0021-SA	Soil, POL Storage (Site 28)	PS-7
1060-SO-021-GS-88-01	001403-0020-SA	Soil, POL Storage (Site 28)	PS-8
1060-SO-001-GS-88-01	001403-0001-SA	Soil, Fuel Spill (Site 29/29A)	FS-1
1060-SO-002-GS-88-01	001403-0002-SA	Soil, Fuel Spill (Site 29/29A)	FS-2
1060-SO-003-GS-88-01	001403-0003-SA	Soil, Fuel Spill (Site 29/29A)	FS-3
1060-SO-004-GS-88-01	001403-0004-SA	Soil, Fuel Spill (Site 29/29A)	FS-4
1060-SO-005-GS-88-01	001403-0005-SA	Soil, Fuel Spill (Site 29/29A)	FS-5
1060-NS-005-GN-88-02	001403-0006-SA	Aqueous, Fuel Spill (Site 29/29A)	FS-5
1060-SO-006-GS-88-01	001403-0007-SA	Soil, Fuel Spill (Site 29/29A)	FS-6
1060-NS-006-GN-88-02	001403-0008-SA	Aqueous, Fuel Spill (Site 29/29A)	FS-6
1060-SO-007-GS-88-01	001403-0010-SA	Soil, Fuel Spill (Site 29/29A)	FS-7
1060-NS-007-GN-88-02	001403-0009-SA	Aqueous, Fuel Spill (Site 29/29A)	FS-7
1060-SO-024-GS-88-01	001403-0023-SA	Soil, Old Landfill (Site 31)	OL-1
1060-SO-025-GS-88-01	001403-0024-SA	Soil, Old Landfill (Site 31)	OL-2
1060-NS-008-GN-88-0002	001390-0013-SA	Aqueous, Husky Landfill (Site 32)	HL-1
1060-NS-008-GS-88-0001	001390-0014-SA	Soil, Husky Landfill (Site 32)	HL-2
1060-SO-009-GN-88-0002	001390-0004-SA	Aqueous, Husky Landfill (Site 32)	HL-3
1060-NS-009-GS-88-0001	001390-0017-SA	Soil, Husky Landfill (Site 32)	HL-4
1060-SO-009-GS-88-0003	001390-0018-SA	Soil, Husky Landfill (Site 32)	HL-4
1060-SO-010-GN-88-0002	001390-0005-SA	Aqueous, Husky Landfill (Site 32)	HL-5
1060-NS-010-GS-88-0001	001390-0010-SA	Soil, Husky Landfill (Site 32)	HL-6
1060-SO-011-GN-88-0002	---	Aqueous, Husky Landfill (Site 32)	HL-7
1060-NS-011-GS-88-0001	001390-0011-SA	Soil, Husky Landfill (Site 32)	HL-8
1060-NS-012-GN-88-0002	---	Aqueous, Husky Landfill (Site 32)	HL-9
1060-NS-012-GS-88-0003	---	Aqueous, Husky Landfill (Site 32)	HL-9
1060-SO-012-GS-88-0001	001390-0012-SA	Soil, Husky Landfill (Site 32)	HL-10
Field Blank	001403-0026-SA	Aqueous, Field Blank	--
Trip Blank	001403-0027-SA	Aqueous, Trip Blank	--
Trip Blank	001390-0009-SA	Aqueous, Trip Blank	--

Flow estimates were made at nine locations along the west edge of the Husky Landfill and adjacent drainage system (locations shown on Drawing No. 3). Additionally, rough estimates were made of the natural ground gradient underneath the pad and the top of the pad. The approximate extent of the Husky Landfill was determined by visual observations on the pad. Several small sink holes in the fill were noted where gravel cover had eroded into large voids in the landfill. The gradient of the natural surface underneath the pad and, therefore, the hydraulic gradient of seepage through the landfill is about 0.003 ft/ft to the west. Several small ponds on the east side contribute to the flow emerging on the west side.

Seepage along the west side of the Husky Landfill was small and exited the fill above the natural ground/fill interface. The total estimated seepage flow was 12 gpm. Inflow from precipitation during the summer on the pad is estimated to contribute about 6 gpm and flow under the pad from ponds on the east side is estimated to contribute about 4 gpm. The remaining portion of the seepage flow could be produced from snowmelt storage in the landfill. Equipment storage on the pad tends to collect large snowdrifts that provide this additional moisture. The loose gravel overlying the fill allows most of the snowmelt to infiltrate into the landfill.

The investigation indicates that about two-thirds of the seepage emanating from the Husky Landfill originates from the east, as infiltration through the Husky Camp gravel pad surface and numerous ponds. The remaining third of the seepage is from rain and snowmelt percolating directly through the landfill pad surface.

3.5 FIELD AND LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

3.5.1 Field Quality Assurance/Quality Control

3.5.1.1 Health and Safety Program. All personnel assigned to field tasks had successfully completed a 40-hour Health and Safety training course. Additionally, the site safety officer briefed the field crew on the Final Health and Safety Plan (WCC 1988c).

3.5.1.2 Sampling Methodology and Protocol. Sample site locations were chosen based on the narrative in the site Quality Assurance Project Plan (QAPP) and the Final Work Plan (WCC 1988a, 1988b). In some cases, site conditions had changed enough that on-site decisions had to be made to choose sample locations representing the previous year's conditions. Prior to sampling, the sampler, gloves, and extension (if required) were decontaminated. The surface water samples were obtained by dipping the sample container into the water at the sample location. All sample locations were close enough to solid ground to eliminate the need to wade into the water being sampled. At locations where flow and volume were insufficient to obtain a large enough sample, a small collection pond was excavated in the drainage course and allowed to sit for a minimum of 24 hours prior to sampling. The sediment samples were obtained using stainless steel spoons to transfer the sediment directly into a sample container. Following water and sediment sampling, the sample labels were completed. All water and fluid used for decontamination were placed in 5-gallon buckets, the lids were sealed, and the buckets were returned to the town of Deadhorse on Prudhoe Bay where they were added to materials removed from POW-3 for shipping to DRMO, Anchorage, Elmendorf AFB.

3.5.1.3 Sample Preservation Methods. The sample team followed all EPA method preservation and handling procedures, container requirements, and maximum holding times for samples, as presented in Table 3-6.

Table 3-6 PRESERVATION AND HANDLING PROCEDURES, AND CONTAINER REQUIREMENTS FOR SOIL AND WATER AT BAR-M, POW-3, AND POW-1

Parameter (EPA Method Nos.)	Sample Volume	Container	Preservatives	Holding Time
Total Petroleum Hydrocarbons (E418.1)	8 oz soil 1L water	8 oz wide-mouth glass 1 L wide-mouth glass	Soil: Chill to 4°C. Water: 5 mL HCl, chill to 4°C.	40 days total 28 days total
Metals (SW6010)	6 oz soil 500 ml water	8 oz wide-mouth glass 500 ml polyethylene bottle	Soil: Chill to 4°C. Water: HNO ₃ to pH<2, chill to 4°C.	6 months; Mercury 28 days
PCBs (SW8080)	8 oz soil	8 oz wide-mouth amber glass with Teflon liner	Soil: Chill to 4°C.	14 days to extraction 40 days total
	2L water	2 1L amber glass	Water: Chill to 4°C.	7 days to extraction 40 days total
3-3 Volatiles (SW8240, SW8010, SW8020)	8 oz soil	4 oz wide-mouth glass with Teflon liner	Soil: Chill to 4°C.	14 days total
	80 mL water	40 mL glass vial with Teflon-lined septum cap.	Water: If no residual chlorine present: add 4 drops 1:1 HCl, chill to 4°C.	14 days total
Total Coliform (SW9132)	500 mL water	2 250 mL polyethylene sterile wrap prior to sampling	Water: Chill to 4°C.	6 hours (Delayed Incubation)

Sources: USEPA, November 1986. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods - Third Edition, SW 846;
 USEPA, March 1983. Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020.
 USEPA, December 1978. Microbiological Methods for Monitoring the Environment, EPA 600/8-78-017.

3.5.2 Laboratory Quality Assurance/Quality Control Program

3.5.2.1 Identification of Laboratory. ENSECO Rocky Mountain Analytical Laboratory (RMAL) Arvada, Colorado provided subcontract laboratory services for this project. Quality assurance (QA) at RMAL encompasses the entire range of activities associated with sample receipt, sample preservation, chemical analyses, and data reporting with emphasis on procedures for assessment, prevention, and correction. The principal components of RMAL's QA are specified in the RMAL Quality Control Program. This program is closely supervised at both the corporate and laboratory levels, and is primarily accomplished through clearly defined objectives, documented procedures, management support, and a comprehensive audit system.

3.5.2.2 Description of Analytical Parameters. All analytical methods have been selected to provide adequate analysis sensitivity for specific hazardous constituents that may be found in water and sediment/soil samples. Each method is identified by its specific EPA number. The methods are from United States Environmental Protection Agency (USEPA), "Methods for Chemical Analysis of Water and Wastes," EPA 600/4-79-020, March 1983; and USEPA, "Test Methods for Evaluating Solid Waste," Vols. 1A, 1B, 1C, 3rd Edition, September 1986. Descriptions of analytical procedures for field programs at the three DEW Line stations and a complete list of analytes are provided in Appendix E. The methods are briefly described below.

Method 6010 is used to determine metals in solution by inductively coupled plasma atomic emission spectroscopy (ICP). The method measures element-emitted light by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific atomic-line emission spectra are produced by a radio-frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer, and the intensities of lines are monitored by photomultiplier tubes. Aqueous samples are filtered for determination of dissolved metals, and digested (Method 3005) for determination of total metals. Soil samples are digested (Method 3050) prior to determination of metal concentrations.

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Method 8010 is used to determine the concentration of various volatile halogenated organic compounds using purge-and-trap gas chromatography with Hall electrolytic conductivity detection.

Method 8020 is used to determine the concentration of various volatile aromatic organic compounds. The method utilizes purge-and-trap gas chromatography, with selective detection achieved by a photo-ionization detector (PID).

Method 8080 provides gas chromatographic conditions for the detection at $\mu\text{g/kg}$ or $\mu\text{g/L}$ levels of certain organochlorine pesticides and PCBs. An aliquot of sample extract is injected into a gas chromatograph (GC) using the solvent flush technique. Compounds in the GC effluent are detected by an electron capture detector (ECD) or a halogen-specific detector (HSD).

Method 8240 is used to determine volatile organic compounds, based upon a purge-and-trap, gas chromatographic/mass spectrometric (GC/MS) procedure. The volatile compounds are introduced into the gas chromatograph by the purge-and-trap method or by direct injection for high concentrations. The components are separated via the gas chromatograph and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information.

Method 418.1 is for the measurement of fluorocarbon-113 extractable petroleum hydrocarbons. A sample is acidified to a low pH (<2) and serially extracted with fluorocarbon-113 in a separatory funnel. Interferences are removed with silica gel adsorbant. Infrared analysis of the extract is performed by direct comparison with standards.

Method 909A is used to determine the presence of a member of a coliform group in wastewater and groundwater. The coliform group analyzed in this procedure includes all of the organisms that produce a colony with a golden-green metallic sheen within 24 hours of inoculation. A predetermined amount of sample is filtered through a membrane filter which

retains the bacteria found in the sample. In the two-step enrichment procedure, the filters containing bacteria are placed on an absorbent pad saturated with lauryl tryptose broth and incubated. The filters are then transferred to an absorbent pad saturated with m-Endo media and incubated. Sheen colonies are then counted under magnification and reported per 100 ml of original sample. When local conditions necessitate delays in delivery of samples longer than 6 hours, field tests are made using field laboratory facilities located at the site of collection, or delayed-incubation procedures are used (EPA Method 909B).

ASTM D 2216 is the standard method for laboratory determination of water (moisture) content of soil, rock, and soil-aggregate mixtures. The practical application in determining the water content of a material is to determine the mass of water removed by drying the moist material (test specimen) to a constant mass in a drying oven controlled at $110 \pm 5^\circ\text{C}$ and to use this value as the mass of water in the test specimen. The mass of material remaining after oven-drying is used as the mass of the solid particles.

3.5.2.3 Laboratory QA/QC Program. The laboratory QA/QC program consists of the operational controls employed to ensure that the data generated meet predefined requirements of precision and accuracy, and the QA/QC system instituted documents the effectiveness of these controls. The environmental sample analysis QA/QC program has been designed to monitor the laboratory's daily performance of an analytical method and to assess the effect of a specific sample matrix on the performance of the analytical method. The standard ENSECO QA/QC program is based on the analysis of the laboratory control sample (LCS). This program is designed to ensure the generation of scientifically valid and legally defensible data. Project-specific quality control data can be generated to assess the effect of the sample matrix on the performance of the analytical method and to obtain additional QC information not part of the ENSECO standard deliverables.

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The concept of the LCS program alleviates the confusion which results from generating QC data obtained using environmental samples, thereby facilitating the evaluation of laboratory performance. This program requires the analysis of LCS samples in duplicate with each lot of 20 environmental samples. LCS samples consist of a suitable standard matrix spiked with a group of target analytes selected to represent the specific method being utilized. Spiking levels are established at a defined level above the method detection limit for each analyte. The purpose of the LCS is not to duplicate the sample matrix, but rather to provide an interference-free, homogeneous matrix to generate QC data. The ENSECO LCS program, using a standard matrix spiked at a single level for all QC samples, will result in the establishment of control limits more restrictive than those provided by the EPA. These control limits are also a more accurate reflection of analytical performance.

The use of a Surrogate Control Sample (SCS) has been established for all organic analyses. The SCS consists of a method blank spiked with surrogate compounds appropriate for the method being used. An SCS is prepared with each batch of samples. The purpose of the SCS is to provide a measure of control for the samples being extracted or analyzed at a particular time between LCS samples, and for this reason it is not analyzed in duplicate as the LCS. The recovery of surrogate compounds from the SCS provides an indication of any analytical problems that occurred during the processing of that lot, while the duplicate LCS samples provide information about the method accuracy and precision.

Control limits for analytes spiked into LCS samples have been initially taken directly from the EPA Contract Laboratory Program (CLP), where such limits have been established. For those analytes and parameters for which no CLP limits have been established, control limits have been established based on RMAL historical data for QC samples. In order to meet regulatory and auditing agency requirements, the LCS (and SCS where applicable) results for each method are monitored using control charts.

At the end of each quarter, control limits are recalculated based upon the most recent 6 months of historical data. The mean and standard deviation for each LCS and SCS analyte are tabulated for each of the two standard matrices. Upper and lower control limits are defined as the mean \pm three standard deviations. Warning limits are established at the mean \pm two standard deviations. For precision control limits, where the minimum value that can be obtained is zero (no difference between the duplicate LCS samples), only upper control limits are defined. For multi-analyte LCS and SCS samples, 80 percent of the calculated values (percent recoveries and RPD values each considered on individual value) must be within the control limits for the QC and associated sample data to be considered acceptable.

4.0

RESULTS AND SIGNIFICANCE OF FINDINGS

4.1 INTRODUCTION

This section discusses the IRP Stage 3 field investigation results and significance of findings for BAR-M, POW-1, and POW-3. Federal and state Applicable or Relevant and Appropriate Requirements (ARARs) are presented in Section 4.2. A general discussion of the qualitative risk screening process is presented in Section 4.3. Soil and water sampling program results and Tier I/Tier II and qualitative risk screening for BAR-M, POW-3, and POW-1 are detailed in Sections 4.4, 4.5, and 4.6, respectively.

Individual chemicals and chemical groups addressed in Section 4.3 on qualitative risk screening do not include acetone, methylene chloride, 2-butanone (methyl ethyl ketone), dichlorofluoromethane, trichlorofluoromethane, and the metals. All of these organic compounds are commonly used laboratory chemicals. They are believed to have been inadvertently introduced into samples at the laboratory. The metals concentrations were found to be within the range of concentrations reported by Shacklette and Boerngen (1984) for metals in soils in Western United States; hence, the metals were not considered contaminants (Table 4-1).

4.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

4.2.1 Introduction

EPA has defined whether a given environmental regulation may constitute an ARAR. Applicable requirements are those promulgated regulations that specifically address a hazardous substance, pollutant, contaminant,

Table 4-1. COMPARISON OF HIGHEST MEASURED HEAVY METALS CONCENTRATIONS IN SOIL AT DEW LINE STATIONS WITH CONCENTRATIONS IN SOILS IN WESTERN UNITED STATES*

Metal	Range of Measured Concentration			Concentration in Soil**	
	BAR-M	POW-1	POW-3	Range	Average
Aluminum	510 - 4100	1200 - 8700	740 - 1700	5000 - >100000	54000
Arsenic	ND	10	ND	<0.2 - 97	6.1
Barium	7.2 - 46	48 - 610	5 - 24	70 - 5000	560
Beryllium	0.1 - 0.2	0.1 - 0.5	0.1	<1 - 7	0.6
Cadmium	ND	0.7 - 1.1	0.6 - 25	<1 - 10	<1
Chromium	1 - 7	17 - 270	2 - 5	3 - 1500	38
Cobalt	1 - 4	2 - 7	1 - 3	<3 - 50	8
Copper	1.8 - 11	7.2 - 58	3.9 - 20	2 - 300	21
Iron	2400 - 11200	1270 - 26800	2400 - 8700	1500 - >100000	20000
Lead	5 - 18	5 - 27	19 - 45	<7 - 700	18
Manganese	32 - 300	73 - 270	19 - 180	30 - 5000	390
Molybdenum	2 - 3	3 - 7	2	<3 - 7	<3
Nickel	5 - 11	5 - 22	3 - 10	<3 - 700	16
Vanadium	1 - 12	11 - 28	3 - 7	7 - 500	66
Zinc	11 - 44	14 - 140	10 - 66	<10 - 2000	51

* Values in mg/kg

ND = Not detected

Source: Shaklette and Boerngen 1984

remedial action, location, or other circumstance at a CERCLA site. Promulgated requirements are those laws and regulations that are of general applicability and are legally enforceable. EPA specifically states in the guideline document that nonpromulgated advisories and guidance documents issued by federal or state governments may be used to determine the level of cleanup necessary to protect human health and the environment. For example, EPA specifically states that the minimum technology requirements for hazardous waste landfills under the Resource Conservation and Recovery Act (RCRA) would apply to a new hazardous waste landfill unit at a CERCLA site.

Even if it is not applicable as defined above, a regulation may be relevant and appropriate. According to EPA, relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements that address problems or situations sufficiently similar to those encountered at a CERCLA site that the use of these requirements is well-suited to the site in question. EPA has classified ARARs into three groups:

- Ambient or chemical-specific requirements that set concentration limits for various environmental media, e.g., ambient water, drinking water, ambient air, soil or solid waste
- Action-specific requirements, e.g., regulations for closure of hazardous waste landfills, RCRA incineration standards, RCRA land disposal prohibitions, and pretreatment standards for discharges to Publicly Operated Treatment Works (POTWs)
- Location-specific requirements are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations, e.g., floodplains, wetlands, historic places.

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4.2.2 Federal and State Regulations

Regulations that could serve as potential ARARs for the three DEW Line Stations are:

- Drinking water standards promulgated under the Federal Safe Drinking Water Act (SDWA 33 USC, Sections 1251 et seq.)
- Drinking water standards established by the State of Alaska (18 Alaska Administrative Code [AAC] 80)
- Water quality criteria established by the State of Alaska (18 AAC 70)
- EPA PCBs spill cleanup policy (Federal Register, Vol. 52, p. 10688)
- Interim standard cleanup guidelines developed by the State of Alaska for total petroleum hydrocarbons (TPHs) (Alaska Department of Environmental Conservation)
- Ambient air quality standards promulgated under the Federal Clean Air Act (CAA, 42 USC, Sections 7901 et seq.).

4.2.3 Federal and State Drinking Water Standards

Federal drinking water standards for the protection of human health are shown in Table 4-2 for the chemical contaminants identified and quantified in soil and water samples from the various station sites at BAR-M, POW-3, and POW-1. Federal drinking water standards have been proposed for PCBs (0.5 µg/L), toluene (2000 µg/L), and xylenes (10,000 µg/L).

4.2.4 Federal and State Ambient Water Quality Criteria

Federal ambient water quality criteria for the protection of human health and freshwater and saltwater organisms are presented in Table 4-2

Table 4-2. DRINKING WATER STANDARDS, AIR QUALITY STANDARDS, AND AMBIENT WATER QUALITY CRITERIA FOR CHEMICAL CONTAMINANTS DETECTED AT BAR-M, POW-3, AND POW-1*

Parameter	Federal Drinking Water Standards	Federal Air Quality Standards	AMBIENT WATER QUALITY CRITERIA (18 AAC 70)					
			Human Health		Freshwater Organisms		Saltwater Organisms	
			Water+Org	Water Only	Acute	Chronic	Acute	Chronic
Aroclor 1254 (PCBs)	0.5**	None	<0.000079	<0.0126	None	None	None	None
Benzene	5	None	0.66	0.67	10	None	10	None
Dichloroethane, 1,1-	None	None	None	None	None	None	None	None
Ethyl Benzene	None	None	1400	2400	None	None	None	None
Toluene	2000**	None	14,300	15,000	None	None	None	None
Total Petroleum Hydrocarbons	None	None	None	None	15	None	15	None
Trichloroethane, 1,1,1-	200	None	18.4	19	None	None	None	None
Trichloroethene	5	None	2.7	2.8	None	None	None	None
Xylenes	10,000**	None	None	None	None	None	None	None

* Values in µg/l

** Proposed standard

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for the chemical substances detected at BAR-M, POW-3, and POW-1. For toxic and other deleterious organic and inorganic substances and for TPHs, Alaska has established minimum standards for ambient water used for aquaculture, seafood processing, industrial processes, and recreation; and for harvesting raw mollusks and other raw aquatic life for human consumption (18 AAC 70). The standards established for marine water uses are presented below. The standards are the same for similar fresh water uses.

4.2.4.1 Aquaculture. Toxic substances shall not individually or in combination exceed 0.01 times the lowest measured 96-hour LC50 for life stages of species identified by the State of Alaska as being the most sensitive, biologically important to the situation, or exceed criteria cited in EPA Quality Criteria for Water or Alaska Drinking Water Standards, whichever concentration is less. (LC50 is an experimentally derived estimate of the concentration of a chemical in water that will kill 50 percent of the exposed population of aquatic organisms.) Substances must not be present or exceed concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms as determined by either bioassay or organoleptic tests.

TPHs levels shall not exceed 0.01 times the continuous-flow 96-hour LC50, or if not available, the static 96-hour LC50 for the species involved.

4.2.4.2 Propagation of Fish and Wildlife. Toxic substances shall not exceed standards for aquaculture.

TPHs in the water column shall not exceed 15 $\mu\text{g/L}$ or 0.01 of the lowest measured continuous flow 96-hour LC50 for life stages of species identified by the State of Alaska as the most sensitive, biologically important species in a particular location, whichever concentration is less. Total aromatic hydrocarbons in the water column shall not exceed 10 $\mu\text{g/L}$ or 0.01 of the lowest measured continuous flow 96-hour LC50 for life stages of

species identified by the State of Alaska as the most sensitive and/or biologically important species in a particular location, whichever concentration is less. There shall be no concentrations of hydrocarbons, animal fats, or vegetable oils in the sediment that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines shall be virtually free from floating oil, film, sheen, or discoloration.

4.2.4.3 Seafood Processing. Toxic substances shall not exceed EPA ambient water quality criteria standards.

TPHs shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils and shall not exceed concentrations which individually or in combination impart odor or taste as determined by organoleptic tests.

4.2.4.4 Industrial Processing. Toxic substances that pose hazards to worker contact shall not be present.

TPHs shall not make the water unfit for the intended industrial use.

4.2.4.5 Water Recreation. Toxic substances shall not exceed EPA ambient water quality criteria standards.

TPHs shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils.

4.2.4.6 Raw Aquatic Life Harvesting. Toxic substances shall not exceed standards for aquaculture.

TPHs shall not exceed concentrations that individually or in combination impart undesirable odor or taste to organisms as determined by bioassay and/or organoleptic tests.

4.2.5 State Interim Petroleum Hydrocarbon Cleanup Standard for Soil

In its Interim Guidance for Soil and Groundwater Cleanup Levels, the Alaska Department of Environmental Conservation (ADEC 1989) established an interim cleanup standard of 100 mg/kg for nongasoline TPHs in soil. The use of alternative soil cleanup levels is permitted by the guidance, provided a risk assessment is conducted to aid in determining them.

Based on the fact that ADEC derived guidance from the California Leaking Underground Fuel Tank (LUFT) manual (California State Water Resources Control Board 1988) in establishing its interim guidance (ADEC 1989), WCC has utilized the LUFT manual to assist us in considering and developing alternative cleanup levels for POW-1. Essentially, the rationale of the LUFT manual is used as the risk assessment required to establish alternative cleanup levels.

For diesel fuel, probably the primary source of TPHs contamination at most Alaskan Air Force stations, the LUFT guidance manual specifies a TPHs cleanup level of 100 mg/kg in the most conservative case; 1000 mg/kg in the intermediate case; and 10,000 mg/kg when the distance to groundwater is greater than 100 feet, where the average annual precipitation is less than 10 inches, where there are no known manmade conduits that increase vertical migration of leachate, and where there are no known unique site features present (such as a nearby recharge area, coarse soil, nearby wells).

4.2.6 EPA Polychlorinated Biphenyls (PCBs) Cleanup Policy for Soil

EPA announced its PCBs spill cleanup policy (Fed. Reg. Vol. 52, p. 10688) on April 2, 1987. The policy applies to intentional and accidental spills of material containing at least 50 mg/L PCBs occurring after April 2, 1987. The policy establishes separate cleanup requirements for low concentration (50 to 500 mg/L) spills involving less than 1 pound of PCBs by weight and high concentration (>500 mg/L) spills involving more than 1 pound of PCBs by weight. For untested mineral oil, a low concentration

spill involves less than 270 gallons of oil and a high concentration spill involves more than 270 gallons of oil. When a low concentration PCBs spill occurs in a nonrestricted access area, visibly contaminated soil and a buffer of 1 lateral foot around the visible traces must be removed and the excavation backfilled with clean soil containing less than 1 mg/kg of PCBs. When a high or low concentration PCBs spill of more than 1 pound of PCBs by weight occurs in a nonrestricted access area, soil containing more than 10 mg/kg PCBs by weight must be removed, provided that soil is excavated to a minimum depth of 10 inches and the excavation backfilled with clean soil.

For spills that occurred before April 2, 1987, cleanup levels are established by EPA regional offices, and this is normally done on a case-by-case basis. EPA Region 10, headquartered in Seattle, has jurisdiction in Alaska. According to the Region 10 office, the April 2, 1987 PCBs cleanup levels are used as guidelines.

4.2.7 Federal Air Quality Standards

Federal air quality standards for the protection of human health are presented in Table 4-2 for the chemical substances detected at BAR-M, POW-3, and POW-1.

4.3 QUALITATIVE RISK SCREENING

4.3.1 Introduction

The qualitative risk screening process presented here was developed by WCC to streamline decisions on waste cleanup at non-NPL sites that are DOD facilities. This approach utilizes qualitative risk analysis, and relies heavily on logic and inferences in lieu of elaborate sampling data to support risk assessment decisions. The risk screening process was developed to rapidly identify chemically contaminated sites at USAF facilities that could have a significant impact on human health and the environment. This risk screening process is proposed as appropriate for

these remote, marginally contaminated, non-NPL DEW Line sites. The process is less rigorous than the risk assessments associated with NPL CERCLA sites. It uses a decision analysis approach whereby yes or no answers to certain questions allow conclusions to be drawn as to whether or not the chemicals at a site present significant risk to receptors.

4.3.2 Screening Process

Figure 4-1 is a flow diagram describing the qualitative risk screening process. A two-tiered hierarchical decision scheme is employed. For Tier I, two criteria were established: evidence of chemical contamination at the site and proximity of the site to sensitive biological receptors. The presence of chemical substances in soil or water samples at concentrations above background levels was considered evidence of contamination. The proximity criterion was scored positive when residences, businesses, or ecologically sensitive areas were present within a 1-mile radius of a site. If an assessment is made that the site is in close proximity to sensitive receptors or if there is evidence that chemicals have been released to the environment, screening proceeds to Tier II. Only one criterion must be satisfied to proceed to Tier II. If neither criterion is satisfied, then the risk is negligible and the no action alternative is recommended.

The Tier II element of the risk screening process involves assessing receptor exposure potential and the probable consequences of receptor exposure to chemical substances. Receptor exposure is considered possible when at least one of the following criteria is judged significant: contaminant release mechanisms, contaminant migration pathways, or high environmental persistence of one or more contaminants. Threshold exceedance is considered possible when both of the following criteria are judged significant: the quantity or concentration of one or more contaminants exceed applicable federal and state standards or criteria based on toxicity data, and the duration or frequency of exposure is sufficient to cause health or environmental adverse effects. If health and environmental standards or criteria are absent, then the potential high

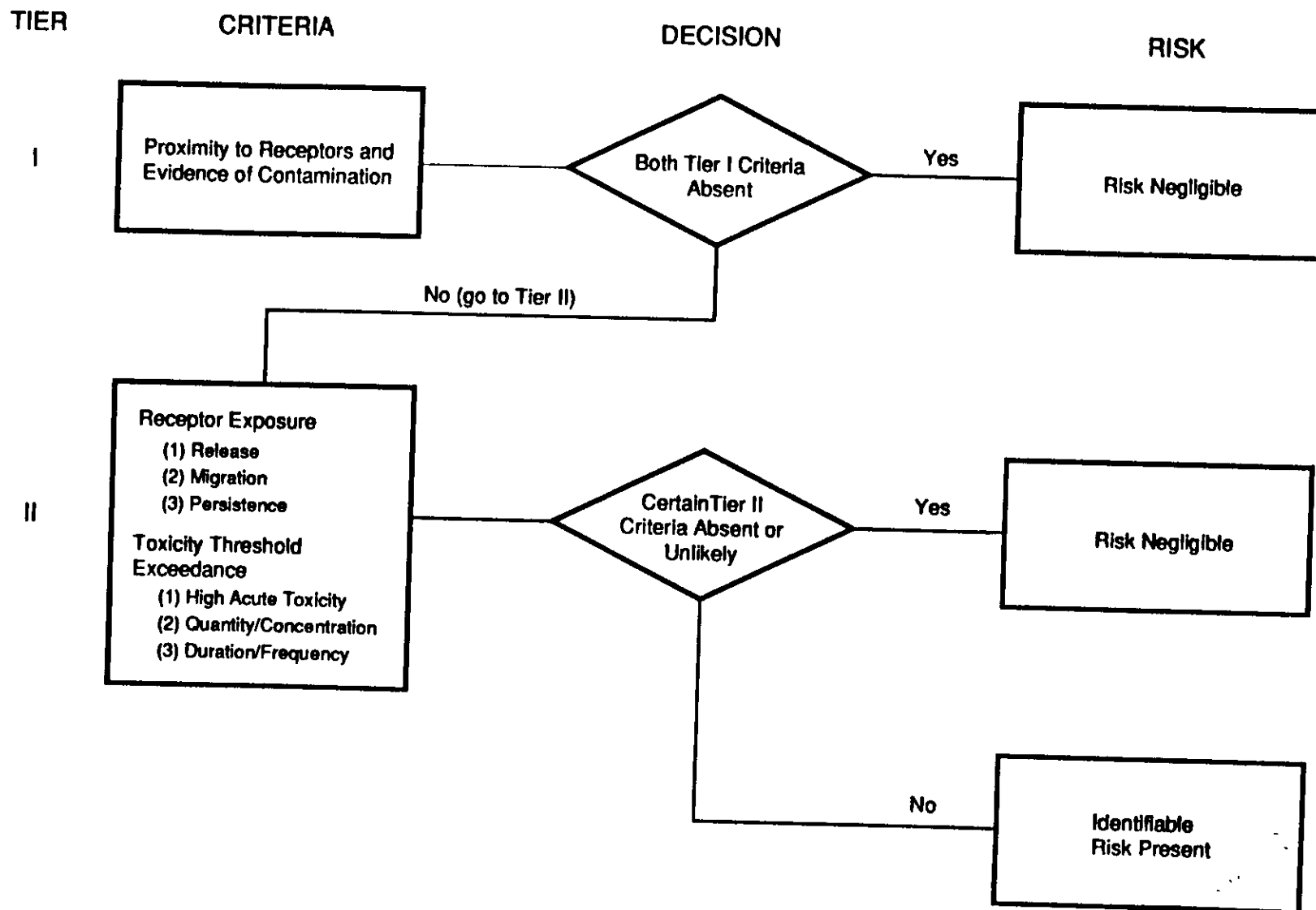


Figure 4-1. FLOW DIAGRAM SHOWING TWO LEVELS OF RISK SCREENING AND CRITERIA FOR DECISION MAKING AT EACH LEVEL

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acute toxicity of the contaminant on the receptors is considered in the risk screening process. In summary, for Tier II, risk is classified as significant when at least one receptor exposure criterion and two threshold exceedance criteria are satisfied.

The potential for contaminant release and migration was judged to be significant when investigations by WCC produced evidence of release and/or migration. The presence of contaminants in surface or groundwater was considered evidence of contaminant release; and the presence of contaminants in a downgradient stream, lake, pond, or lagoon at elevated concentrations was considered evidence of migration. When no evidence was available, the potential for release and migration was assessed by evaluating selected physical properties of the contaminants, primarily aqueous solubility, vapor pressure, octanol-water partition coefficient (Log P), and soil-water partition coefficient (Kow). High aqueous solubility and vapor pressure promote contaminant release and migration. Log P values provide a reasonable estimate of the propensity of a chemical to bind to soil containing organic material as well as to bioaccumulate. The propensity to bind to soil and to bioaccumulate increases with the value of Log P. Kow values also provide a measure of the propensity of a compound to bind to soil particles.

The National Institute for Occupational Safety and Health (NIOSH) toxicity rating system was used to identify contaminants highly toxic to mammals (NIOSH 1975). The system ranks substances according to acute toxicity estimates (LD50s and LC50s), the customary method used to compare chemicals with respect to toxicity. Highly toxic substances are those with an oral LD50 equal to or less than 50 mg/kg (body weight), dermal LD50 equal to or less than 100 mg/kg (body weight), or inhalation LC50 equal to or less than 43 ppm (volume/volume). A similar ranking system has not been developed for aquatic organisms; however, aquatic toxicologists generally agree that chemicals with a 48- or 96-hour LC50 of 1 mg/L or less are highly toxic to aquatic life.

LD50, with "L" meaning lethal and "D" dose, is an experimentally derived estimate of the chemical dose that will kill 50 percent of the exposed population of organisms. Dose is expressed in unit weight of chemical per unit weight of organism and is used when the chemical is administered orally, dermally, or parenterally (by injection).

When the organisms are exposed to a chemical in air or water, the amount to which the organisms are exposed is called concentration; thus, the expression becomes LC50, with "L" meaning lethal and "C" concentration. LC50 estimates for mammalian inhalation toxicity are expressed in parts-per-million (ppm), volume-volume (V/V), or unit weight of chemical per cubic meter of air (usually mg/m^3). LC50 estimates for aquatic organisms are expressed as unit weight of chemical per liter of water (usually mg/L).

Measured contaminant concentrations were compared with health and environmental standards and criteria for the contaminants to identify standard and criteria exceedances. When only human populations were at risk, only health criteria and standards were used. When the populations at risk were nonhuman (e.g., fish, wildlife, vegetation), only environmental criteria and standards were used. Exposure duration or frequency was considered significant when site contaminants were found in or could migrate to drinking water, ambient air, or surface water inhabited by important aquatic organisms; and their concentrations, upon reaching receptors, were estimated as being high enough to cause effects; or when there was evidence of toxic effects.

4.4 BARTER ISLAND AFS (BAR-M)

4.4.1 Sampling Program Results

Soil and water sample locations at BAR-M are shown on Drawing No. 1. Table 4-3 shows the highest measured concentration of each chemical

Table 4-3. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS DETECTED IN SOIL/SEDIMENT AT BARTER ISLAND AFS (BAR-M) SITES

Parameter	Old Landfill (Site 1)				Sewage Lagoon (Site 2)	POL Catchment Area (Site 3)							New Landfill (Site 4)				Contaminated Ditch (Site 8)		
	OL-1	OL-2	OL-4	OL-5	SL-3	PB-1	PB-2	PB-3	PB-4	PB-5	PB-6	PB-7	NL-1	NL-2	NL-3	NL-4	CD-1	CD-2	CD-3
<u>Organics (mg/kg)</u>																			
Total Petrol. Hydroc.	96	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Other Analytes ^a	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	ND	ND

ND = Not detected

-- = Not tested

^a Refer to Appendix E, Table E-2.

contaminant detected in soil samples, and Table 4-4 shows the highest measured concentration of each chemical contaminant detected in surface water samples in the Stage 3 field investigation.

4.4.1.1 Old Landfill (Site 1). One Old Landfill soil/sediment sample contained TPHs at a concentration of 96 mg/kg. Two Old Landfill surface water/leachate samples contained TPHs at concentrations of 0.7 and 0.8 mg/L. Leachate at the Old Landfill contained up to 2 MPN (most probable number)/100 ml total coliform.

4.4.1.2 Sewage Lagoon (Site 2). The Sewage Lagoon wastewater contained from 1100 to 4000 MPN/100 ml total coliform. Coliform levels were found to be higher than the federal drinking water standards for total coliforms. This indicates that the Sewage Lagoon is contaminated with animal feces. Consequently, the water in the lagoon may contain pathogenic microorganisms for which total coliform counts are indicators (coliform bacteria, such as Escherichia coli, are not pathogenic). This qualitative risk screening process was designed to evaluate chemicals, not biologicals; hence, coliforms were not assessed by the process.

4.4.1.3 POL Catchment Area (Site 3). At the POL Catchment Area, TPHs were reported in one surface water/leachate sample at the detection limit of 0.5 mg/L.

4.4.1.4 New Landfill (Site 4). In the New Landfill surface water/leachate samples, 1,1-dichloroethane concentrations ranged from ND to 3.9 µg/L, trichloroethene from ND to 18 µg/L, benzene from ND to 40 µg/L, toluene from ND to 34 µg/L, ethyl benzene from ND to 7.2 µg/L, m-xylenes from ND to 12 µg/L, o- & p-xylenes from ND to 8 µg/L, and TPHs from ND to 3.0 mg/L.

4.4.1.5 Contaminated Ditch (Site 8). In the Contaminated Ditch surface water/leachate samples, TPHs concentrations ranged from ND to 1.0 mg/L.

Table 4-4. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS DETECTED IN SURFACE WATER/LEACHATE AT BARTER ISLAND AFS (BAR-M) SITES

Parameter	Old Landfill (Site 1)					Sewage Lagoon (Site 2)			POL Catchment Area (Site 3)			New Landfill (Site 4)				Contaminated Ditch (Site 8)			
	OL-1	OL-2	OL-3	OL-4	OL-5	SL-1	SL-2	SL-3	PB-1	PB-2	PB-3	NL-1	NL-2	NL-3	NL-4	CD-1	CD-2	CD-3	CD-4
<u>Organics (µg/L)</u>																			
1,1-Dichloroethane	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	3.9	ND	ND	ND	--
Trichloroethene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	18	ND	ND	ND	--
Benzene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	14	40	ND	ND	ND	--
Toluene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	23	34	ND	ND	ND	--
Ethyl benzene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	7.2	ND	ND	ND	--
m-Xylene	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	12	ND	ND	ND	--
o & p-Xylene(s)	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	8	ND	ND	ND	--
Other Analytes ^a	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	ND	ND	--
<u>Total Petrol. Hydroc. (mg/L)</u>																			
	0.8	ND	ND	0.7	ND	ND	ND	ND	ND	ND	0.5	0.7	ND	ND	3.0	ND	0.7	ND	1.0
<u>Wastewater (mpn/100 ml)</u>																			
Total Coliform	--	ND	--	2	--	1100	4000	--	--	--	--	--	--	--	--	ND	ND	ND	--

ND = Not detected

-- = Not tested

^a Refer to Appendix E, Table E-3.

4.4.2 Deviations and Corrective Actions

4.4.2.1 Deviations from the Statement of Work. At BAR-M, the following field work deviations from the Final Work Plan (WCC 1988a) occurred during IRP Stage 3 field investigation:

- POL Catchment Area (Site 3): At the direction of USAFOEHL/TS, one of the four POL Catchment Basin water samples (sample location PB-04), to be collected "outside of the visibly contaminated area," was used for WCC water sample No. 1042-NS-016-GN-88-0002 at the Contaminated Ditch.
- Contaminated Ditch (Site 8): A petroleum-based product was observed seeping from the ground into the Contaminated Ditch immediately north of the culvert underlying the main road. Therefore, at the direction of USAFOEHL/TS, a new water sample, labeled WCC No. 1042-NS-016-GN-88-0002 was taken to assess contamination at this location in the ditch.
- New Landfill (Site 4): Sample location NL-01, to assess upgradient background levels, was relocated closer and upgradient of the landfill in a more protected area.

4.4.2.2 Analytical Problems and Corrective Actions. At BAR-M, the following analytical problems were reported by the laboratory, as elaborated in the specified data reports:

- Samples WCC No. 1042-SO-001-GS-88-0001, 1042-SO-004-GS-88-0001, 1042-SO-005-GS-88-0001, 1042-SO-006-GS-88-0001, 1042-SO-020-GS-88-0001, and 1042-SO-021-GS-88-0001 were multiphasic. These samples consisted of approximately 50 percent water and 50 percent soil or sediment. These samples were treated as soil samples by the laboratory and the soil fraction was analyzed for Method SW8240.

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- The holding times were exceeded on samples WCC No. 1042-NS-005-GN-88-0002, 1042-NS-006-GN-88-002, 1042-NS-020-GN-88-0002, 1042-NS-021-GN-88-0002, 1042-NS-021-GN-88-0003, 1042-NS-022-GN-88-0002, 1042-NS-002-GN-88-0001, and 1042-NS-003-GN-88-0001. These samples for total coliform analysis arrived at the laboratory after the recommended 6-hour holding time had passed. Although the holding times were exceeded, total coliform counts indicate that pathogenic microorganisms may be present.
- The magnesium result from the dissolved sample WCC No. 1042-NS-008-GN-88-0001 was higher than the magnesium result in the recoverable sample. Interferences during sample preparation may result in poor recoveries of some cations, particularly magnesium, sodium, and calcium. Since the metals concentrations are near or below background levels, the magnesium results do not affect the significance of findings for this sample location.
- Acetone was detected in soil samples WCC Nos. 1042-S0-012-GS-88-0001, 1042-S0-005-GS-88-0001, and 1042-S0-006-GS-88-0001. In addition to acetone, 2-butanone was detected in soil sample WCC No. 1042-S0-012-GS-88-0001. Acetone and 2-butanone are commonly used laboratory solvents and their concentrations were near respective detection limits; therefore, they can be treated as negligible and attributable to a laboratory artifact.
- Trichlorofluoromethane was detected in surface water samples WCC Nos. 1042-NS-011-GN-88-0002, 1042-NS-021-GN-88-0002, and 1042-NS-022-GN-88-0002. Methylene chloride was detected in surface water sample WCC No. 1042-NS-012-GN-88-0003. In addition, trichlorofluoromethane and methylene chloride were detected in the WCC ambient condition blank. These samples were packaged and shipped in a single ice chest and the detected concentrations may be due to cross-contamination between samples. These compounds

are common laboratory solvents and their concentrations were near respective detection limits; therefore, they can be treated as negligible and attributable to a laboratory artifact.

4.4.3 Tier I Screening

4.4.3.1 Evidence of Contamination. At BAR-M, evidence of soil contamination (TPHs, chlorinated hydrocarbon, and several substitute benzenes) was reported at the Old Landfill, Site 1 (Section 4.4.1.1) and the New Landfill, Site 4 (Section 4.4.1.4). Evidence of TPHs surface water contamination was reported at the Old Landfill, Site 1; the POL Catchment Area, Site 3 (Section 4.4.1.2); the New Landfill, Site 4; and the Contaminated Ditch, Site 8 (Section 4.4.1.5).

4.4.3.2 Proximity to Receptors. According to the risk screening criteria, the proximity of a site to a biological population of concern is considered significant if the distance between the site and the population is 1 mile or less. The village of Kaktovik (population about 250) is located about 0.5 mile east of the station, and the sites are located within a 1000-foot-radius circle. This places all of the sites within 1 mile of the village and within 1000 feet of the Beaufort Sea. Near-shore areas of the Beaufort Sea off Barter Island are inhabited by several species of fish including arctic char, arctic flounder, chum salmon, chinook salmon, and arctic cisco.

4.4.3.3 Summary of Tier I Screening. The results of the Tier I screening process are presented in Table 4-5. All of the sites were scored as being in close proximity to sensitive receptors and all but the Sewage Lagoon had evidence of chemical contamination.

4.4.4 Tier II Screening

4.4.4.1 Potential for Release and Migration. The presence of TPHs in surface water samples from all of the sites, except the Sewage Lagoon, and the presence of chlorinated hydrocarbons, benzene, and substituted benzenes

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Table 4-5. TIER I QUALITATIVE RISK SCREENING FOR BARTER ISLAND AFS (BAR-M) SITES

Tier I Criteria	Old Landfill (Site 1)	Sewage Lagoon (Site 2)	POL Catchment Area (Site 3)	New Landfill (Site 4)	Contaminated Ditch (Site 8)
Is Site in Close Proximity to Sensitive Receptors?	Yes	Yes	Yes	Yes	Yes
Is Evidence of Contamination Present at Site?	Yes	No	Yes	Yes	Yes
Risk	Go to Tier II	Go to Tier II	Go to Tier II	Go to Tier II	Go to Tier II

in surface water at the New Landfill were taken as evidence for contaminant release and migration at BAR-M. All of the individual compounds are soluble in water. Solubilities range from 152 mg/L for ethyl benzene to 600 mg/L for benzene (Table 4-6). In addition, they all have low sediment-water partition coefficients, meaning that their propensity to bind to soil particles is low. Both of these properties promote migration via water.

4.4.4.2 Persistence. None of the individual compounds found in the water samples are persistent in surface soil and water. All of the compounds have moderate to high vapor pressures (Table 4-6), and volatilization is probably the primary pathway of removal of those compounds from soil and water. The lowest reported half-lives of the individual compounds range from 0.17 days for toluene to 1.5 days for ethyl benzene and the xylenes (EPA 1986). Ten half-lives would reduce the concentrations of these compounds to a little less than 1 percent of initial values. The persistence of TPHs cannot be predicted because the composition of the entity is unknown. All TPHs can be metabolized by microorganisms; however, the metabolic rate decreases as the molecular weight of the hydrocarbon increases. Low molecular weight hydrocarbons have higher vapor pressures than high molecular weight hydrocarbons, so such hydrocarbons are less persistent than those with high molecular weights. Because they are biodegradable, TPHs were not considered environmentally persistent. Contaminant persistence at BAR-M was thus scored insignificant.

4.4.4.3 Toxicity. Oral, dermal, and inhalational acute toxicity estimates for mammals and 48- or 96-hour acute toxicity estimates for freshwater organisms available in the literature are shown in Table 4-6. None of the compounds detected at BAR-M for which acute toxicity estimates are available meets the criterion for high toxicity.

4.4.4.4 Contaminant Quantity and Concentration. The concentration of benzene in surface water from the New Landfill exceeded the federal drinking water standard and the Alaska ambient water quality criterion.

Table 4-6. PHYSICAL AND TOXICOLOGICAL PROPERTIES OF SOIL AND WATER CONTAMINANTS, DEW LINE STATIONS (BAR-M, POW-3, AND POW-1)

Contaminant	Aqueous Solubility (mg/L)	Vapor Pressure (torr)	LOG P	Oral LD50 in Rats (mg/kg)	Dermal LD50 in Rabbits (mg/kg)	Inhal. LC50 in Rats (ppm, v-v)	48-/96-hour LC50 in Aquatic Organisms (mg/L)
Aroclor 1254	0.07	0.0000771	6.03	1010	NI	NI	0.01
Benzene	600	76	2.13	3306	NI	10,000	220
Dichloroethane, 1,1-	5500	180	1.79	725	NI	NI	480
Ethyl Benzene	152	7	3.15	3500	17,800	4000*	10
Toluene	515	22	2.69	5000	12,124	4000	4.3
TPHs	NI	NI	NI	NI	NI	NI	NI
Trichloroethane, 1,1,1	1495	124	2.17	10,300	3730	18,000	NI
Trichloroethene	1100	58	2.29	3670	NI	8000*	45
Xylenes	175	6	2.77	4300	NI	4550	10

* = Lowest lethal concentration

NI = No Information

The concentration of TPHs in surface water/leachate samples from all BAR-M sites except the Sewage Lagoon exceeded the Alaska standards. Contaminant concentration detected in surface water at the New Landfill was thus scored significant. Contaminant concentration was scored insignificant at the other BAR-M sites based on test results of other compounds.

4.4.4.5 Duration and Frequency of Exposure.

4.4.4.5.1 Human Exposure. This assessment assumes that the primary mechanism by which humans would be exposed to site contaminants is through migration of the contaminants via water to drinking water supplies. Surface water and groundwater at the sites flow toward the Beaufort Sea, not toward the village of Kaktovik. It is thus highly unlikely that village drinking water supplies have been, or will be, contaminated by chemicals found in soil and water samples from the sites. Consequently, the duration and frequency of human exposure to site contaminants via drinking water are insufficient to cause adverse effects.

4.4.4.5.2 Aquatic Organisms. The major direction of surface water flow from the sites is toward the Beaufort Sea. Thus, surface water contaminants could enter the sea. However, because the contaminants are not persistent, the frequency and duration of exposure were considered insignificant.

4.4.4.6 Summary of Tier II Screening. A summary of the results of the BAR-M Tier II screening process is presented in Table 4-7. Risk was classified as insignificant at all of the sites; hence, no further action is necessary at the BAR-M sites investigated in this IRP Stage 3 sampling program. Nevertheless, potential future environmental problems were recognized at three locations at BAR-M, and therefore remedial actions in the form of IRMs were recommended at the Old Landfill, New Landfill, and Sewage Lagoon.

Table 4-7. TIER II QUALITATIVE RISK SCREENING FOR BARTER ISLAND AFS (BAR-M) SITES

Tier II Criteria	Old Landfill (Site 1)	Sewage Lagoon (Site 2)	POL Catchment Area (Site 3)	New Landfill (Site 4)	Contaminated Ditch (Site 8)
<u>Exposure</u>					
Significant Release Mechanisms (or)	Yes	No	Yes	Yes	Yes
Significant Migration Pathways (or)	Yes	No	Yes	Yes	Yes
High Persistence	No	No	No	No	No
[AND]					
<u>Threshold Exceedance</u>					
Quantity/Concentration Sufficient to Exceed Applicable Health/ Environmental Standards or Criteria (and)	Yes	No	Yes	Yes	Yes
Duration and Frequency of Exposure Sufficient to Cause Adverse Effects	No	No	No	No	No
-----[OR]-----					
Highly Toxic* (and)	NA	NA	NA	NA	NA
Duration and Frequency of Exposure Sufficient to Cause Adverse Effects	NA	NA	NA	NA	NA
Risk	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

NA = Not applicable

* If applicable health/environmental standard or criterion absent.

4.5 BULLEN POINT AFS (POW-3)

4.5.1 Sampling Program Results

Soil and water sample locations at POW-3 are shown on Drawing No. 2. Table 4-8 details the highest measured concentration of each chemical contaminant detected in soil samples. No chemical contaminants were detected in surface water samples in the Stage 3 field investigation. The Inside Transformer (Site 4) and the Old Landfill (Site 6) are the only two POW-3 sites where soil samples were collected for analytical laboratory testing. Water samples were also collected at the Old Landfill.

4.5.1.1 Shed No. 1 (Site 1). Soil and water samples were not collected at this site for analytical laboratory tests.

4.5.1.2 Shed No. 2 (Site 2). Soil and water samples were not collected at this site for analytical laboratory tests.

4.5.1.3 Outside Transformers (Site 3). Soil and water samples were not collected at this site for analytical laboratory tests.

4.5.1.4 Inside Transformer (Site 4). In the two Inside Transformer soil/sediment samples, Aroclor 1254 was detected in concentrations of 3.9 and 5.9 mg/kg. These samples were collected from beneath the Module Train. Oil collected from the transformer located inside the Module Train was reported by the analytical laboratory with less than the detection limit of 1.1 mg/kg for Aroclor 1254.

A review of field test and laboratory analytical data at first suggests that the leaking transformer is not the contributing factor for soil contamination. The field test performed by WCC engineers for PCBs, using the McGraw-Edison PCBs Field Test Kit, was inconclusive as to the presence of PCBs in the transformer oil. A matrix interference probably associated with moisture in the transformer oil was apparent at the time of the field test; a white precipitation was observed in the sample jar. The same interference may have affected the analytical laboratory tests performed on

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Table 4-8. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS
DETECTED IN SOIL/SEDIMENT AT BULLEN POINT AFS (POW-3) SITES*

Parameter	Inside Transformer (Site 4)			Old Landfill (Site 6)			
	IT-1**	IT-2	IT-3	OL-1	OL-2	OL-3	OL-4
<u>Organics (mg/kg)</u>							
Aroclor 1254	ND**	3.9	5.9	ND	ND	ND	ND
Total Petroleum Hydrocarbons	--	--	--	ND	138	ND	ND
Other Analytes***	ND	ND	ND	ND	ND	ND	ND

ND = Not detected

-- = Not tested

* Soil samples were not collected for analytical laboratory testing at the following sites: Shed No. 1 (Site 1), Shed No. 2 (Site 2), Outside Transformer (Site 3), and POL Tanks (Site 5).

** Waste Sample

*** Refer to Appendix E, Table E-5.

the transformer oil sample. Oil samples from the stained floor were not collected for PCBs analysis. Although the field and laboratory tests are inconclusive, the leaking transformer may have contributed to the PCBs soil contamination beneath the Module Train.

Historically, PCBs oil was used at DEW Line stations. The indoor transformers at POW-3 probably contained PCBs oil (Heavy Duty Electric Company 1988). Five-gallon cans of PCBs oil were removed from Shed No. 1 (Site 1) during the Summer 1988 sample removals program. In addition, the transformer and most of the oil-saturated floor tiles were removed from the Inside Transformer (Site 4) in the Module Train. The building floor insulation was not removed from the site and may have absorbed PCBs oil (Section 3.3.3).

4.5.1.5 POL Tanks (Site 5). Soil and water samples were not collected at this site for analytical laboratory tests.

4.5.1.6 Old Landfill (Site 6). In the Old Landfill soil/sediment samples, TPHs concentrations ranged from ND to 138 mg/kg.

4.5.2 Deviations and Corrective Actions

4.5.2.1 Deviations from the Statement of Work. At POW-3, the following field work deviations from the Final Work Plan occurred during the IRP Phase 3 field investigations:

- Shed No. 2 (Site 2): A 5-gallon can of lube oil was found in the shed. An emulsified petroleum product at least 1 inch thick was lying over 4 to 6 inches of frozen water. Based on the identifying label on the can and the appearance of the liquid on the floor, the field test for halogens was not performed and sample S2-1 was not collected for laboratory analysis.
- Outside Transformer (Site 3): The contents of the Outside Transformer were found to be nitrogen filled. This assessment was based on the identification plate attached to the transformer

housing. Therefore, the PCBs field test was not performed and the planned PCBs sample, OT-1, was not collected for laboratory analysis.

- Inside Transformer (Site 4): Gravel and soil under the building were not stained. Based on this observation, soil was not removed from beneath the building. The PCBs field test was not performed on the gravel beneath the building. Soil samples WCC Nos. 1062-NS-007-GS-88-0001 and 1062-NS-008-GS-88-0001 were collected for laboratory analysis.

4.5.2.2 Analytical Problems and Corrective Actions. At POW-3, the following analytical problems were reported by the laboratory, as elaborated in the specified data reports:

- The soil sample WCC No. 1062-SO-005-GS-88-0001 missed the 28-day extraction and 40-day analysis deadlines for TPHs, EPA Method 418.1. The results for this sample will be considered as an estimate of the actual concentration.
- The pesticide QC Lot #880916A showed low recoveries for heptachlor and aldrin for both laboratory control samples. The relative percent differences between Laboratory Control Sample (LCS) #1 and LCS #2 were high for lindane, heptachlor, aldrin, and endrin. The surrogate recoveries for the samples are in control. ENSECO Rocky Mountain Analytical Laboratory (RMAL) determined that this anomaly was limited to the LCS because the surrogate recoveries were within control limits. The LCS extracts were reanalyzed showing similar recoveries.
- Trichlorofluoromethane was detected in water samples WCC Nos. 1062-NS-001-GN-88-0001 and 1062-NS-002-GN-88-0002. In addition, trichlorofluoromethane was detected in the trip blank WCC No. 1062-NS-010-GN-88-0001. The reported concentrations may be from sample handling, shipment, or laboratory contamination. Because

this chemical is a commonly used laboratory solvent, it will not be considered further.

4.5.3 Tier I Screening

4.5.3.1 Evidence of Contamination. At POW-3, evidence of soil contamination was reported at the Inside Transformer, Site 4 (Section 4.5.1.4) and at the Old Landfill, Site 6 (Section 4.5.1.6). No evidence of surface water contamination was reported at POW-3. The simple removals program eliminated the potential contamination sources from Sites 1 and 2 and the Generator Room; therefore, Sites 1 and 2 were not included in the qualitative risk screening. Sites 3 and 5 were not subject to the screening process.

4.5.3.2 Proximity to Receptors. According to the risk screening criteria, the proximity of a site to a biological population of concern is considered significant if the distance between the site and the population is 1 mile or less. POW-3 is very isolated. No human activity exists on a continuing basis in the area; no villages are located within miles, and the station is not manned.

POW-3 is located within a mile of a portion of the Beaufort Sea called Mikkelsen Bay and within a mile of several small shallow lakes that freeze in the winter. Mikkelsen Bay is inhabited by a variety of aquatic organisms. Important fish species include chum and chinook salmon, arctic cisco, arctic char, and arctic flounder. Thus, both sites satisfy the proximity-to-receptor criterion.

4.5.3.3 Summary of Tier I Screening. The results of the Tier I screening process for Sites 4 and 6 are presented in Table 4-9. The results were to proceed to Tier II for both sites.

4.5.4 Tier II Screening

4.5.4.1 Potential for Release and Migration. Aroclor 1254 is a mixture of PCBs. On the average, the PCBs constituting Aroclor 1254 are almost insoluble in water and have a very high soil-water partition coefficient

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Table 4-9. TIER I QUALITATIVE RISK SCREENING FOR BULLEN POINT AFS (POW-3) SITES*

Tier I Criteria	Inside Transformer (Site 4)	Old Landfill (Site 6)
Is Site in Close Proximity to Sensitive Receptors?	Yes	Yes
Is Evidence of Contamination Present at Site?	Yes	Yes
Risk	Go to Tier II	Go to Tier II

* The simple removals program eliminated the potential contamination sources from Shed No. 1 (Site 1), Shed No. 2 (Site 2), and the Generator Room (no site number) and, therefore, were not included in the qualitative risk screening. In addition, the Outside Transformer (Site 3) was found to be nitrogen-filled and not hazardous; and the POL Tanks (Site 5) were inspected for potential fuel contents (Section 3.3.3).

(Kow) of 530,000. Because of these properties, Aroclor 1254 is unlikely to desorb appreciably from soil when water passes over or through the soil. Migration would occur when contaminated particles of soil are carried with surface water runoff. Because the contaminated soil is beneath the Module Train, entrainment by surface water runoff is unlikely. The potential for release and migration of Aroclor 1254 from the Inside Transformer site was scored insignificant.

TPHs is a name given to the substance or substances extractable from samples with Freon and quantifiable by infrared spectroscopy. TPHs are a mixture of hydrocarbon compounds, the composition of which usually differs among samples. Based on the assumption that the source of TPHs in the Old Landfill site is petroleum-based fuel or oil, compounds comprising TPHs at the site probably consist of high molecular weight hydrocarbons, such as polynuclear aromatic hydrocarbons and the waxes, which are sparingly soluble in water and have very low vapor pressures, making them similar to Aroclor 1254 with regards to propensity for release and migration. Thus, the potential for petroleum hydrocarbon release and migration from the Old Landfill was scored insignificant.

4.5.4.2 Persistence. It is generally acknowledged that PCBs are extremely persistent compounds; hence, persistence was scored significant for the Inside Transformer site. TPHs, on the other hand, are biodegradable. The rate of biodegradation decreases as the molecular weight of the hydrocarbon increases, and low soil temperatures can appreciably reduce the rate of degradation of all hydrocarbons, regardless of molecular weight. Nevertheless, because TPHs are biodegradable and were the only contaminant detected at the Old Landfill site, contaminant persistence at the Old Landfill site was scored insignificant.

4.5.4.3 Toxicity. An LC50 of 0.01 mg/L has been reported for Aroclor 1254 in aquatic organisms. According to the risk screening scheme, chemicals with LC50s of 1.0 mg/L or less in aquatic organisms are considered highly toxic. Therefore, the toxicity of Aroclor 1254 was scored significant, even though it was not found in water. TPHs are not a single compound.

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Because TPHs compositions are not fixed, the toxicity of TPHs cannot be accurately predicted. However, since high molecular weight TPHs exhibit low acute toxicity to mammals and aquatic life, the toxicity of TPHs was scored insignificant.

4.5.4.4 Contaminant Quantity and Concentration. TPHs in soil exceed the draft Alaska Interim Guidance for Soil and Groundwater Levels (ADEC 1989). No standards exist for PCBs (Aroclor 1254) in soil; therefore, a toxicity criterion was evaluated in the risk screening process.

4.5.4.5 Duration and Frequency of Exposure

4.5.4.5.1 Human Exposure. POW-3 is not manned and there are no villages within miles of the station. The area is occasionally visited by hunters and fishermen for short periods of time (perhaps a few days). The duration and frequency of human exposure to chemical contaminants were considered insignificant.

4.5.4.5.2 Aquatic Organisms. No surface water/leachate water samples were taken at POW-3. Migration of PCBs detected in the soil samples at the Inside Transformer site to Mikkelsen Bay was determined to be unlikely. The frequency and duration of exposure to aquatic organisms were considered insignificant.

4.5.4.6 Summary of Tier II Screening. The results of the Tier II screening process are presented in Table 4-10. The chemicals found at both sites do not present a significant risk to human health or the environment. Thus, no further action is necessary at POW-3 sites.

4.6 POINT LONELY AFS (POW-1)

4.6.1 Sampling Program Results

Soil and water sample locations at POW-1 are shown on Drawing No. 3. Table 4-11 details the highest measured concentration of each chemical contaminant detected in soil samples, and Table 4-12 details the highest measured concentration of each chemical contaminant detected in surface water collected during the Stage 3 field investigation.

Table 4-10. TIER II QUALITATIVE RISK SCREENING FOR BULLEN POINT AFS
(POW-3) SITES

Tier II Criteria	Inside Transformer (Site 4)	Old Landfill (Site 6)
EXPOSURE		
Significant Release Mechanisms (or)	No	No
Significant Migration Pathways (or)	No	No
High Persistence	Yes	No
[AND]		
THRESHOLD EXCEEDANCE		
Quantity/Concentration Sufficient to Exceed Applicable Health/ Environmental Standards or Criteria (and)	NA	Yes
Duration and Frequency of Exposure Sufficient to Cause Adverse Effects	NA	No
-----[OR]-----		
Highly Toxic* (and)	Yes	NA
Duration and Frequency of Exposure Sufficient to Cause Adverse Effects	No	NA
Risk	Insignificant	Insignificant

NA = Not applicable

* If applicable health/environmental standard or criterion absent.

Table 4-11. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS DETECTED IN SOIL/SEDIMENT AT POINT LOWLY AFS (POW-1) SITES

Parameter	Old Sewage Outfall (Sites 25/27)			POL Storage Area (Site 28)							Large Fuel Spill (Sites 29/29A)							Old Landfill (Site 31)		Husky Landfill (Site 32)					
	SO-1	SO-2	SO-3	PS-1	PS-2	PS-3	PS-4	PS-5	PS-7	PS-8	FS-1	FS-2	FS-3	FS-4	FS-5	FS-6	FS-7	OL-1	OL-2	HL-2	HL-4	HL-6	HL-8	HL-10	
<u>Organics (mg/kg)</u>																									
Toluene	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	0.1	0.32	ND	ND	
Total Xylenes	14	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	0.28	0.66	ND	ND	
Other Analytes*	ND	ND	ND	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	ND	ND	
<u>Total Petrol.</u>																									
<u>Hydroc. (mg/kg)</u>	1300	72	ND	290	40	140	5400	1000	ND	ND	25000	830	ND	840	ND	ND	ND	ND	77	1900	43	200	1600	62	

ND = Not detected

-- = Not tested

* Refer to Appendix E, Table E-8.

Table 4-12. HIGHEST MEASURED CONCENTRATIONS OF CHEMICAL CONTAMINANTS DETECTED IN SURFACE WATER/LEACHATE AT POINT LONELY AFS (POW-1) SITES*

Parameter	Old Sewage Outfall (Sites 25/27)	POL Storage Area (Site 28)	Large Fuel Spill (Sites 29/29A)			Husky Landfill (Site 32)				
	SO-1	PS-6	FS-5	FS-6	FS-7	HL-1	HL-3	HL-5	HL-7	HL-9
<u>Organics (ug/L)</u>										
1,1-Dichloroethane	ND	--	--	--	--	ND	ND	3.6	ND	ND
1,1,1-Trichloroethane	ND	--	--	--	--	ND	ND	10	ND	ND
Trichloroethene	ND	--	--	--	--	2.6	11	ND	ND	ND
Benzene	190	--	--	--	--	2.7	130	93	ND	ND
Toluene	380	--	--	--	--	3.2	240	270	ND	ND
Ethyl benzene	57	--	--	--	--	ND	32	32	ND	ND
m-Xylene	1600	--	--	--	--	2.0	96	84	ND	ND
o & p-Xylene(s)	350	--	--	--	--	3.4	120	97	ND	ND
Other Analytes**	ND	--	--	--	--	ND	ND	ND	ND	ND
<u>Total Petroleum Hydrocarbons (mg/L)</u>	6	2	3	1	1	.5	2	.5	2	1

ND = Not detected

-- = Not tested

* Water samples were not collected for analytical laboratory testing at the Old Landfill (Site 31).

** Refer to Appendix E, Table E-9.

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4.6.1.1 Old Sewage Outfall and Beach Tanks (Sites 25/27). At the Old Sewage Outfall, soil/sediment sample results included total xylenes concentrations ranging from ND to 14 mg/kg and TPHs concentrations ranging from ND to 1300 mg/kg. Surface water/leachate sample results included benzene concentrations at 190 µg/L, toluene at 380 µg/L, ethyl benzene at 57 µg/L, m-xylene at 1600 µg/L, o- & p-xylenes at 350 µg/L, and TPHs at 6.0 mg/L.

4.6.1.2 POL Storage Area (Site 28). At the POL Storage Area, TPHs in soil/sediment ranged from ND to 5400 mg/kg, and TPHs in surface water/leachate were detected at 2.0 mg/L.

4.6.1.3 Large Fuel Spill (Sites 29/29A). At the Large Fuel Spill, TPHs concentrations in soil/sediment samples ranged from ND to 25,000 mg/kg and in surface water/leachate samples from 1.0 to 3.0 mg/L.

4.6.1.4 Old Landfill (Site 31). At the Old Landfill, TPHs in soil/sediment ranged from ND to 77 mg/kg. No other organic contaminants were detected by the analytical laboratory.

4.6.1.5 Husky Landfill (Site 32). The following organic contaminants were found in soil/sediment samples at the POW-1 Husky Landfill: toluene from ND to 0.32 mg/kg, total xylenes from ND to 0.66 mg/kg, and TPHs from 43 to 1900 mg/kg. Organic contaminants detected in surface water/leachate samples collected at the Husky Landfill included 1,1-dichloroethane from ND to 3.6 µg/L, 1,1,1-trichloroethane from ND to 10 µg/L, trichloroethene from ND to 11 µg/L, benzene from ND to 130 µg/L, toluene from ND to 270 µg/L, ethyl benzene from ND to 32 µg/L, m-xylenes from ND to 96 µg/L, o-and p-xylenes from ND to 120 µg/L, and TPHs from 0.5 to 2.0 mg/L.

4.6.2 Deviations and Corrective Actions

4.6.2.1 Deviation from the Statement of Work. The following field work deviations from the Final Work Plan occurred during the IRP Stage 3 field investigations at POW-1:

- Old Sewage Outfall (Site 25): The Final Work Plan allowed for a sediment sample (sample location SO-1) to be collected at the sewage outfall, if it could be located. A site reconnaissance and interviews with station personnel did not provide the necessary information to physically locate the outfall. However, station personnel did alert the sampling team to a zone along the beach with persistent petroleum odors. Sediment sample WCC No. 1060-SO-013-GS-88-0001 was taken in that identified zone.
- Old Landfill (Site 31): The Work Plan allowed for two leachate samples (sample locations OL-3 and OL-4) to be collected at a leachate zone. Because there was no observable leachate, these samples were not used at Site 31. However, sample WCC No. 1060-NS-026-GS-88-0001 was used for a water sample at the Old Sewage Outfall.

4.6.2.2 Analytical Problems and Corrective Actions. At POW-1, the following analytical problems were reported by the laboratory, as elaborated in the data report:

- Soil samples WCC No. 1060-SO-010-GS-88-0001 and 1060-SO-011-GS-88-0001 were diluted for the pesticide analysis due to matrix interferences and the detection limits were raised accordingly. Aldrin, lindane, and heptachlor could not be accurately quantified in the matrix spike and matrix spike duplicate due to matrix interferences. The results for these samples will be considered as estimates of the actual concentrations.
- Due to matrix interference, the recovery could not be calculated for the pesticide surrogate DBC for water sample WCC No. 1060-NS-009-GN-0001.
- Dichlorodifluoromethane was detected in surface water sample WCC No. 1060-NS-008-GN-88-0002. Trichlorofluoromethane was not

detected in surface water samples. In addition, trichloro-fluoromethane was detected in the WCC field blank. The reported concentrations may be from sample handling, shipment, or laboratory contamination as these chemicals are commonly used laboratory solvents. Therefore, the detection of this contaminant will not be considered further.

4.6.3 Tier I Screening

4.6.3.1 Evidence of Contamination. At POW-1, evidence of soil contamination was reported at the Sewage Outfall and Beach Tanks, Sites 25/27 (Section 4.6.1.1); the POL Storage Area, Site 28 (Section 4.6.1.2); the Large Fuel Spill, Sites 29/29A (Section 4.6.1.3); the Old Landfill, Site 31 (Section 4.6.1.4); and the Husky Landfill, Site 32 (Section 4.6.1.5). Evidence of surface water contamination was reported at the Sewage Outfall and Beach Tanks, Sites 25/27; the POL Storage Area, Site 28; the Large Fuel Spill, Sites 29/29A; and the Husky Landfill, Site 32. The presence of TPHs, benzene and substituted benzenes, and chlorinated ethanes and ethylenes in soil and/or water samples was considered sufficient evidence of contamination at the POW-1 sites.

4.6.3.2 Proximity to Receptors. According to the risk screening criteria, the proximity of a site to a biological population of concern is considered significant if the distance between the site and the population is 1 mile or less. POW-1 is very isolated. No human activity exists on a continuing basis in the area outside the station; and no villages are located within miles. The station is manned by about 17 people.

POW-1 is located within a mile of the Beaufort Sea and within a mile of several small shallow lakes that freeze to the bottom in the winter. The nearshore area of the Beaufort Sea is inhabited by a variety of aquatic organisms. Important fish species include chum and chinook salmon, arctic cisco, arctic char, and arctic flounder. The five sites were thus classified as being in close proximity to station personnel and aquatic life.

4.6.3.3 Summary of Tier I Screening. The results of the Tier I screening process are presented in Table 4-13. The results were to proceed to Tier II for all sites.

4.6.4 Tier II Screening

4.6.4.1 Potential for Release and Migration. TPHs were found in surface water samples from all of the POW-1 sites. Benzene and substituted benzenes were found in water samples from the Old Sewage Outfall (Site 25/27) and the Husky Landfill (Site 32); chlorinated ethanes and ethylenes were detected in water samples from the Husky Landfill. In accordance with the qualitative risk screening procedure, the presence of contaminants in water is evidence of release. TPHs and certain other contaminants were also detected in downgradient water bodies. This is evidence of migration.

4.6.4.2 Persistence. None of the individual compounds found in the water samples are persistent in surface soil and water. All samples have moderate to high vapor pressures (Table 4-6), and volatilization is probably the primary pathway of removal of those compounds from soil and water. The lowest reported aqueous half-lives of the individual compounds range from 0.17 days for toluene to 1.5 days for ethyl benzene and the xylenes (EPA 1986). Ten half-lives would reduce the concentrations of these compounds to a little less than 1 percent of initial values. The persistence of TPHs cannot be predicted because the composition of the entity is unknown. All TPHs can be metabolized by microorganisms; however, the metabolic rate decreases as the molecular weight of the hydrocarbon increases. Low molecular weight hydrocarbons have higher vapor pressures than high molecular weight hydrocarbons, so such hydrocarbons are less persistent than those with high molecular weights. Because they are biodegradable, TPHs were not considered environmentally persistent. Contaminant persistence at POW-1 was thus scored insignificant.

4.6.4.3 Toxicity. Oral, dermal, and inhalational acute toxicity estimates for mammals and 48- or 96-hour acute toxicity estimates for freshwater organisms available in the literature are shown in Table 4-6. None of the compounds for which acute toxicity estimates are available meets the criterion of high toxicity.

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Table 4-13. TIER I QUALITATIVE RISK SCREENING FOR BULLEN POINT LONELY AFS (POW-1) SITES

Tier I Criteria	Old Sewage Outfall (Sites 25/27)	POL Storage Area (Site 28)	Large Fuel Spill (Sites 29/29A)	Old Landfill (Site 31)	Husky Landfill (Site 32)
Is Site in Close Proximity to Sensitive Receptors?	Yes	Yes	Yes	Yes	Yes
Is Evidence of Contamination Present at Site?	Yes	Yes	Yes	Yes	Yes
Risk	Go to Tier II	Go to Tier II	Go to Tier II	Go to Tier II	Go to Tier II

4.6.4.4 Contaminant Quantity and Concentration. The concentration of benzene in surface water samples from the Husky Landfill (Site 32) and Old Sewage Outfall (Sites 25/27) exceeded the federal drinking water standard and ambient water quality criterion. At the POW-1 sites, soil/sediment and water/leachate samples were analyzed for TPHs. TPHs were found above the Alaska interim standards in surface water/leachate samples at all tested sites; and in soil/sediment samples at all sites except the Old Landfill.

4.6.4.5 Duration and Frequency of Exposure.

4.6.4.5.1 Human Exposure. Human exposure to site contaminants is assumed to be significant only if the contaminants reach the lake from which station water is drawn. This lake is located more than $\frac{1}{2}$ mile from each of the sites. The amount of rainfall in the area is very low and the terrain between the sites and the lake is essentially flat. It is unlikely that contaminants from the sites will reach the drinking water lake; hence, the duration and frequency of human exposure to site contaminants were not considered adequate to cause adverse effects.

4.6.4.5.2 Aquatic Organisms. The major direction of surface water flow from the sites is toward the lagoon and Beaufort Sea. Thus, surface water contaminants could enter the sea. However, because the contaminants are not persistent, the frequency and duration of exposure were considered insufficient.

4.6.4.6 Summary of Tier II Screening. The results of the Tier II screening process are presented in Table 4-14. Risk associated with the contaminants at the sites was considered insignificant based on toxicity data. Although this conclusion suggests that no further action is necessary at any of the sites, the concentration of TPHs at all of the sites, except the Sewage Outfall, exceeded Alaska's interim cleanup standard of 100 mg/kg for TPHs in soil.

At POW 1, groundwater is an unreliable drinking water resource and is not used as a source; therefore, groundwater TPHs contamination does not

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Table 4-14. TIER II QUALITATIVE RISK SCREENING FOR POINT LONELY AFS (POW-1) SITES

Tier II Criteria	Old Sewage Outfall (Sites 25/27)	POL Storage Area (Site 28)	Large Fuel Spill (Sites 29/29A)	Old Landfill (Site 31)	Husky Landfill (Site 32)
EXPOSURE					
Significant Release Mechanisms (or)	Yes	Yes	Yes	Yes	Yes
Significant Migration Pathways (or)	Yes	Yes	Yes	Yes	Yes
High Persistence	No	No	No	No	No
[AND]					
THRESHOLD EXCEEDANCE					
Quantity/Concentration Sufficient to Exceed Applicable Health/ Environmental Standards or Criteria (and)	Yes	Yes	Yes	No	Yes
Duration and Frequency of Exposure Sufficient to Cause Adverse Effects	No	No	No	No	No
-----[OR]-----					
Highly Toxic* (and)	NA	NA	NA	NA	NA
Duration and Frequency of Exposure Sufficient to Cause Adverse Effects	NA	NA	NA	NA	NA
Risk	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant

NA = Not applicable

* If applicable health/environmental standard or criterion absent.

thereaten drinking water supplies. All other conditions specified by the LUFT evaluation for the 10,000-mg/kg limit are met at POW-1. Therefore, utilizing the 10,000-mg/kg level, cleanup would be necessary only at the Large Fuel Spill (Sites 29/29A) where TPHs concentrations were detected up to 25,000 mg/kg.

5.0 FEASIBILITY STUDY ALTERNATIVES AND INITIAL REMEDIAL MEASURES

5.1 INTRODUCTION

The results of the qualitative risk screening presented in Section 4.0 indicated that only the Large Fuel Spill (Sites 29/29A) at POW-1 required consideration of remedial action in a feasibility study (FS). The engineering and hydrologic studies at BAR-M, POW-3, and POW-1 indicated the desirability of considering Initial Remedial Measures (IRMs) to ameliorate or remedy, with relatively simple means, situations that could potentially present environmental problems. The development, evaluation, and comparison of alternative remedial measures for both types of situations, the FS at POW-1 and the IRMs at BAR-M, POW-3, and POW-1 are described herein.

In accordance with OEHL and CERCLA/SARA guidelines, the evaluations of remedial alternatives for the FS and IRMs were done to different levels of detail. The FS at POW-1 was done according to the requirements of the USAFOEHL/TS Handbook, which itself is patterned after CERCLA and SARA requirements. In contrast, the IRMs alternatives evaluations were straightforward comparisons of alternatives.

5.2 BARTER ISLAND AFS (BAR-M) INITIAL REMEDIAL MEASURES

The scope of field work at BAR-M included a hydrologic evaluation of the facility and an engineering investigation of the Old Landfill (Sections 3.2.3 and 3.2.4). These studies resulted in some recommendations and the identification of some alternative remedial measures that are discussed in the following sections.

5.2.1 Old Landfill Erosion

5.2.1.1 Background. As discussed in Section 3.2.4, the Bar-M Old Landfill is currently being eroded, primarily by coastal processes of the Beaufort Sea, and landfill debris is entering the environment. This is a continuing problem due to the ongoing retreat of the bluff on which the Old Landfill is located.

5.2.1.2 Remedial Alternatives. Alternatives considered include no action and two landfill debris mitigations. The no action alternative involves essentially continuing the present practice of letting the landfill erode and handling debris problems as they occur. Mitigation of the landfill debris release into the environment can be accomplished by either removal of the landfill debris away from the erosion front or protection of the erosion front from further erosion.

The no action alternative, which serves as a baseline for the landfill debris mitigation alternatives, requires no major remedial actions. Monitoring the bluff regression by visual observation and possibly by field measurement, and beach debris cleanup may be a part of this alternative.

Removal of the landfill debris away from the erosion face will halt the release of debris into the environment. Disturbance caused by the removal may temporarily increase the erosion rate where the operations occurred. Retreat of the bluff southward and possible widening of the west drainage could be expected. The debris could be removed from the erosion face, then removal could be continued working away from the erosion face. The advantages of this approach are that, depending on schedule, local labor and some equipment available at Barter Island could be used. A disadvantage is that an additional disposal area, such as expansion of the existing New Landfill, would be required. Based on historical aerial photographs and on-site field measurements, the total volume of debris in the Old Landfill is estimated to be 25,000 m³. The volume of debris within

50 meters of the ocean bluff and 20 meters of the stream is about 8000 m³. These estimates are based on the assumption that the depth of the exposed edge (i.e., thickness of the landfill is approximately 2 m) remains constant. It is considered probable that removing the Old Landfill back 50 meters from the bluff would essentially be a 50-year solution to the problem based on the estimated 1 m/yr rate of bluff retreat.

Protection of the erosion face can be accomplished by construction of a retaining wall or by using riprap (either natural stone or manmade concrete blocks). The advantage of leaving the landfill in its present location is that disturbance of the area would be minimized and no additional landfill capacity elsewhere would be required. The main disadvantage is that as the natural erosion of the adjacent bluff continues, the sides of the Old Landfill will become exposed and will be subjected to erosion. This erosion at the edges of the retaining wall or riprap will require maintenance in the future.

5.2.1.3 Estimated Costs of Alternatives. Cost estimates for the outlined IRMs are presented in Table 5-1. Section 6.0 presents a comparative rating and ranking of these alternatives, and a selection of the recommended IRM.

5.2.2 New Landfill Leachate Generation

5.2.2.1 Background. As discussed in Section 3.2.3.4, at least half and possibly most of the leachate emanating from the north side of the New Landfill originates as infiltration through the top of the New Landfill. A comparatively smaller amount is believed to enter the New Landfill as surface waterflow on its south and less on its west and east sides. Thus, treating the top of the landfill to make it less pervious is expected to substantially reduce leachate generation in the landfill and north side landfill outflow. This treatment is recommended for the inactive portion of the New Landfill as an IRM.

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Table 5-1. BARTER ISLAND AFS (BAR-M) OLD LANDFILL INITIAL REMEDIAL MEASURE (IRM) COST ESTIMATES

IRM	COST ESTIMATE
1a Remove 8000 m ³ of the Old Landfill that is within 50 m of the bluff and 20 m of the stream in 1 summer with outside labor and equipment, and place the material adjacent to the existing New Landfill on a new gravel pad. Includes health and safety training costs for outside labor.	\$400,000
1b Remove 8000 m ³ of the Old Landfill with local labor and equipment over a period of 8 years, and place the material adjacent to the existing New Landfill on a new gravel pad. Includes health and safety training costs for outside labor.	350,000
<u>Structures to Protect Erosion Face</u>	
2a Concrete block riprap protection with the blocks cast on site in 1 summer.	550,000
2b Natural stone riprap barged in from western Alaska in 1 summer.	850,000
2c Piling protection (retaining wall) for the bluff and cast concrete riprap protection for the creek in 1 summer	700,000

Note: Costs are rounded to the nearest \$ thousand. These costs are presented as January 1989 dollars. Effects of inflation are not included.

5.2.2.2 Remedial Alternatives. Potential remedial measures to render the top of the New Landfill less permeable all involve improved cover materials and grading the cover to enhance rapid runoff. Cover thicknesses are based on standard engineering practice. Specific covers considered include the following:

- Less pervious native cover material about 1½ to 2 feet thick (least thickness for clayey sandy silt and greatest thickness for silty sand)
- Cover material about 1½ feet thick, consisting of native granular material with bentonite admixture
- Synthetic membrane 30- to 40-mil thick, covered by 1 foot of native granular material.

Use of relatively impervious native cover material would appear to be the simplest and lowest-cost New Landfill IRM alternative. However, this material is in short supply at Barter Island. It may be possible to obtain such material from overburden removed from a borrow site or by progressive scraping off of newly thawed material from a newly opened area. The latter method would appear to have significant negative environmental impact.

The second New Landfill IRM alternative is to use local coarse-grained material with addition of bentonite to reduce its permeability. This approach avoids the need to locate and develop local fine-grained fill sources. Bentonite could be added also to the top 6-inch layer of the existing landfill cover to reduce the thickness of new soil-bentonite material to 12 inches. The subgrade and the new fill should be compacted in 6-inch layers to minimize permeability. No significant problems are anticipated in shipping the required quantities of bentonite to BAR-M and in locating and developing sources of suitable coarse-grained fill.

The third New Landfill IRM alternative is to grade and smooth the existing landfill cover, place an impervious synthetic cold-climate membrane consisting of 30- to 40-mil high density polyethylene (HDPE), and then cover the membrane with 1 foot of compacted local coarse-grained fill. Placement and welding (thermally fusing) the membrane will require specially trained personnel. A 20-year service life can reasonably be expected from the HDPE membrane in the severe arctic climate.

5.2.2.3 Estimated Cost of Alternatives. Cost estimates for the outlined initial remedial measures are presented in Table 5-2. Section 6.0 presents a comparing, rating, and ranking of these alternatives; and a selecting of the recommended IRM.

5.2.3 Sewage Lagoon Leakage

5.2.3.1 Background. As discussed in Section 3.2.3, seepage from the Sewage Lagoon is believed to occur through the gravel berm on the west, north, and east sides during the annual thaw period. The seepage discharges into three different drainages. In addition, concentrated seepage was observed near an existing culvert at the northwest corner of the Sewage Lagoon.

The distributed seepage is a design element of the lagoon containment and is in fact necessary to maintain the hydraulic equilibrium of the lagoon; i.e., to annually dispose of an amount of liquid roughly equal to the annual addition. Short of entirely reconstructing/repairing the enclosing gravel berm and treating the annual inflow of sewage to the facility before ocean discharge, no reasonable remediation is apparent. Therefore, any remediation considered here would have the purpose of reducing receptor exposure to the seepage.

5.2.3.2 Remedial Alternatives. The seepages to the west and to the east are reasonably well-channeled toward the Old Landfill Ditch and the Contaminated Ditch. To the north, the seepage is dispersed onto the tundra over

Table 5-2. BARTER ISLAND AFS (BAR-M) NEW LANDFILL COVER INITIAL REMEDIAL MEASURE (IRM) ALTERNATIVE COST ESTIMATES

IRM	COST ESTIMATE
1 New Landfill cover (2 feet thick) with less-pervious native material	\$248,000
2 New Landfill cover (1 foot thick) with granular native material and bentonite admixture	266,000
3 High Density Polyethylene (30-40 mil.) and New Landfill cover (1 foot thick) of granular native material	356,000

Note: Costs are rounded to the nearest \$ thousand. These costs are presented as January 1989 dollars. Effects of inflation are not included.

about the first 100 feet north of the berm, until it is channeled into the small drainageway crossing over the Old Landfill to the northwest. Consideration was given to improving the channelization of this seepage. However, any excavation for channels could lead to uncontrolled thermal and seepage erosion, and is therefore not recommended. Consideration was also given to fencing the area to the north and northeast of the Sewage Lagoon, where distributed seepage flow discharges and disperses over the tundra. However, considering the scarcity of potential receptors that would be restrained from entering the area, the difficulty of identifying the exact area to be fenced, the cost of fencing, and the potential negative effects of the construction activities and of future snow accumulations at the fence, this alternative is not recommended.

Finally, WCC considers the concentrated seepage at the northwest corner a potential threat to the integrity of the gravel berm, because internal erosion working its way upgradient along the pipe may be occurring. Any simple remedy would not be designed to reduce or stop the continuing seepage, but is designed to minimize erosion. Construction of an inverted filter is recommended for the purpose. This will be done by hand-excavating under and around the pipe back about 12 to 18 inches into the berm, then backpacking the excavation first with a well-graded filter material and subsequently with 1- to 2-inch drain rock. The surface of the rock material should approximately match or be higher than the adjacent gravel berm surface. It is estimated that a total of about ten 90-pound bags of filter and rock material may be required. The work performed should be supervised by a geotechnical engineer. The expected effectiveness of the repair would be documented in an engineering report.

5.2.3.3 Estimated Cost of Erosion Control Measures. The estimated cost of the remediation of erosion by seepage along the pipe in the northwest corner is nominal, on the order of \$5000 for acquiring and transporting the filter and rock materials, constructing the inverted filter, and documenting the construction.

5.3 BULLEN POINT AFS (POW-3) POL TANKS INITIAL REMEDIAL MEASURE

The DEW Line SOW for POW-3 specified the inspection of the POL tanks at the station. Seven diesel fuel tanks were visually inspected during the field program. The tank surfaces were badly deteriorated and rusted, particularly on the seaward sides. The tanks were secured to concrete pads by bottom support angle brackets that showed signs of corrosion. Surface soils adjacent to the concrete pad appeared to be stained by the rusting.

The quantity of diesel fuel remaining in the tanks could not be assessed. The bolt-down tank hatches were not removed for interior tank inspections because the access ladders were hazardous and not usable. The liquid level gages appeared to be inoperable because of substantial corrosion. Measurement readings indicated less than 4-6 inches of product remaining in each of the tanks. Typically, aboveground tanks are designed so that suction pipelines will not completely drain the tank. This design minimizes sucking up tank bottom contents that may contain sludge and water. No information is available on the POL tank decommissioning procedures at the time POW-3 was abandoned in 1971. It is reasonable to expect that tank bottom material (i.e., sludge, water) and fuel may remain in the POL tanks. It is recommended that the POW-3 POL tanks be decommissioned, emptied, and possibly cleaned in order to prevent future leakage.

5.4 POINT LONELY AFS (POW-1) HUSKY LANDFILL INITIAL REMEDIAL MEASURE

The field investigation of the POW-1 Husky Landfill indicated that there are three seepage sources: the Husky Camp gravel pad surface, numerous ponds to the east, and rain and snowmelt percolating directly through the pad surface into the landfill. Two-thirds of the seepage emanates from the east, and the remaining third is estimated to be from direct percolation onto the landfill.

An IRM is recommended to remedy potential environmental problems at the Husky Landfill. The purpose of the IRM is to minimize water flow through the landfill, and thereby minimize leachate generation. Remediation would require independent remedial efforts for each of the three sources of water flow. To control inflow from direct precipitation, sources creating snowpack accumulation could be moved, and the permeable gravel cover over the fill could be capped with less permeable materials and graded to promote drainage away from the landfill. Flow from the eastside ponds could be controlled by creating a positive surface drainage channel to the south into an existing drainage system that flows southwest away from the pad into the tidal flats. Controlling infiltration from the Husky Camp pad could be achieved by construction of a cutoff wall on the east side of the Husky Landfill. A shallow grout curtain or soil-bentonite slurry wall could be used. This wall would simultaneously control seepage from ponds to the east.

An alternative method to minimize leachate flow would be to draw the permafrost surface up into the landfill by adding cover material over the landfill. If enough fill were added to raise the permafrost surface about 2 feet, the relatively impervious permafrost could change the subsurface hydraulic gradient enough to prevent the eastern seepage from entering the landfill mass, with a resultant decrease in leachate generation.

5.5 POINT LONELY AFS (POW-1) LARGE FUEL SPILL FEASIBILITY STUDY

5.5.1 Introduction

Although the conclusion of the qualitative risk screening identified in Section 4.6 suggests risk associated at the Large Fuel Spill (Sites 29/29A) is considered insignificant, the total petroleum hydrocarbons (TPHs) concentration exceeds Alaska's interim cleanup standards. This section presents an FS that evaluates remedial action technologies applicable to the POW-1 Large Fuel Spill. The technologies are screened in Section 5.5.2

on a technical basis, using data about contaminants and site characteristics collected in the RI. Section 5.5.3 divides the contaminated site into operable units representing areas that can be addressed together due to surface geological conditions. In Section 5.5.4, remedial alternatives are assembled from the appropriate technologies as a result of the screening process. In Sections 5.5.5 and 5.5.6, the remedial alternatives are evaluated and compared.

This FS generally follows the outline given in the USAF Occupational and Environmental Health Laboratory Technical Services Division's (USAFOEHL/TS) "Handbook to Support the Installation Restoration Program (IRP) Statement of Work for Remedial Investigation/Feasibility Studies (RI/FS)," Version 2.0, April 1988. The Handbook was developed as guidance to contractors in performing feasibility studies at USAF sites. The Handbook is designed to be responsive to SARA and includes language that is appropriate for studies meeting National Priorities List (NPL) criteria. Based on criteria of the EPA CERCLA Program, POW-1 is not a candidate for NPL designation. Therefore, a liberal interpretation of this handbook, leading to a logically rigorous but streamlined FS, is appropriate for POW-1. Due to the remote location of POW-1 north of the Arctic Circle, the FS focuses on remedial actions that accommodate the severe climatic, logistical, and environmental conditions specific to this site.

Weather conditions limit potential out-of-doors remedial action activities to a 3-month working window. Seasonal weather conditions also limit transportation options. When the weather is favorable, transportation to and from the site is limited to two or three barges per year and charter air service as conditions permit. Some years, on average 2 years out of 7, the shorefast ice does not recede, making barge passage to POW-1 impossible.

The fragile tundra environment of northern Alaska is sensitive to many types of commonly employed remedial activities, such as excavation, that

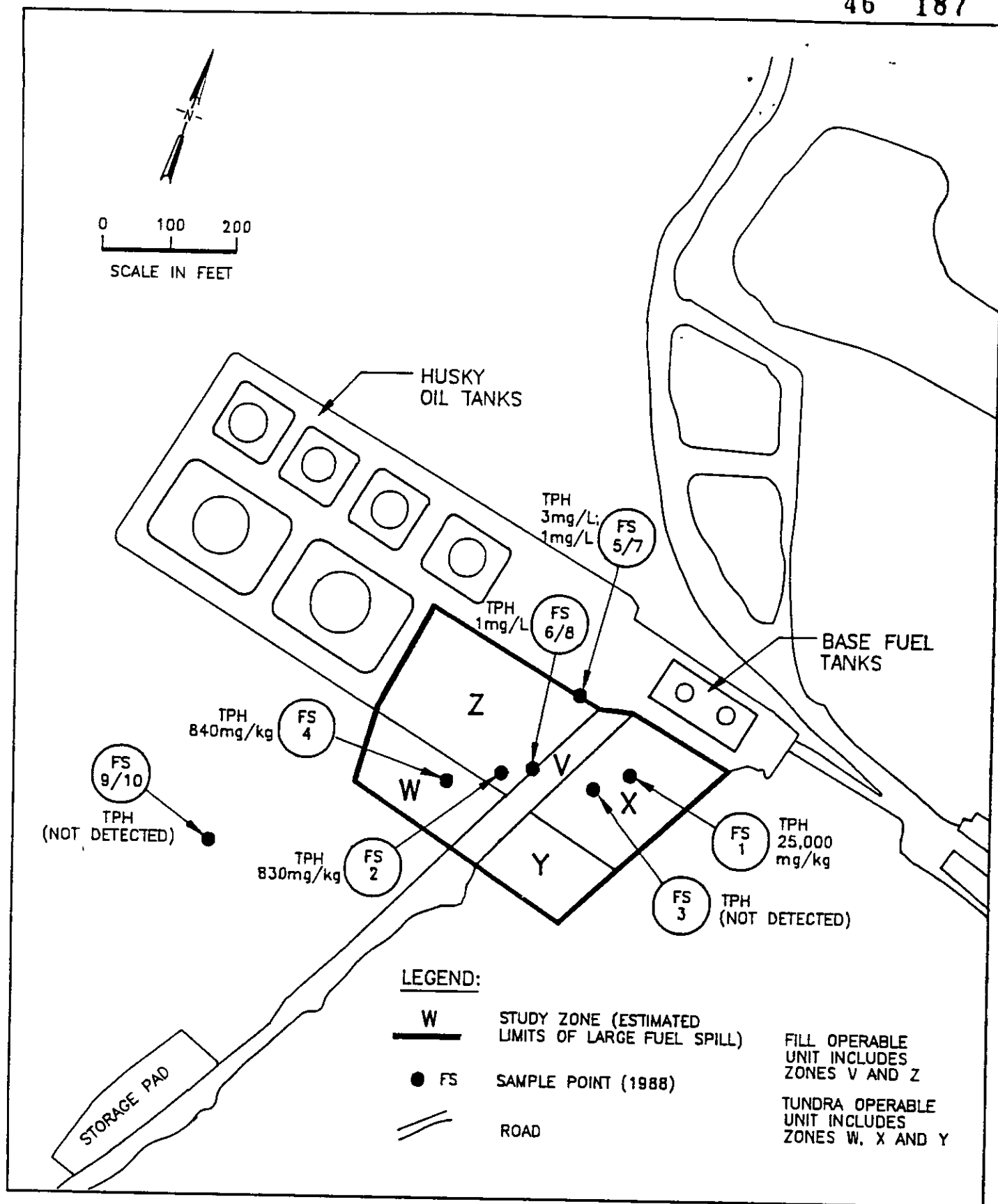
could result in long-term damage. Therefore, remedial actions that do not cause damage to tundra and permafrost should be used when appropriate. The principal focus of the remedial alternatives identification process will be to limit the adverse environmental impact of the remedial action.

Economic factors play a significant role in evaluating potential remedial actions because of the remote location of POW-1. Transportation of equipment and materials to and from the site is costly. Labor rates are high and a premium is paid for imported labor. Since no villages are located nearby, labor, equipment, and some materials needed to implement remedial action will have to be imported.

5.5.1.1 Background and Nature of Contamination. The Large Fuel Spill (Sites 29/29A) area contamination documented in the RI is thought to have resulted from a 1978 fuel line break that spilled diesel fuel onto the ground. The estimated volume spilled was 25,000 gallons; there was no recovery (CH2M HILL 1981). No additional details about the spill or the cleanup operation are reported in IRP reports.

Tables 4-11 and 4-12 in Section 4.0 summarize the maximum concentrations of individual compounds identified in Stage 3 samples from the Large Fuel Spill site. Table 4-11 is a summary of individual peak concentrations for chemical substances found in soil and Table 4-12 summarizes surface water peak concentrations.

Figure 5-1 is a POW-1 site plan of the estimated limits of the Large Fuel Spill area. Five study zones are mapped on Figure 5-1, designated Areas V, W, X, Y, and Z. Area V is a gravel roadbed. Areas W, X, and Y are native tundra, subdivided to allow development of remedial alternatives based on estimated contamination and environmental sensitivity criteria. Area Z is a gravel pad used for POL tank storage. The Phase I report notes a 25,000 gallon spill south of the station's two tanks that are east of the Husky tanks in Area X (CH2M Hill 1981). Although no visible contamination



Project No. 90275J	POINT LONELY AFS (POW-1)	LARGE FUEL SPILL (SITE 29/29A) PHOTO DATE: 9-13-81	Figure 5-1
Woodward-Clyde Consultants			

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was noted in this area during the WCC Summer 1987 field reconnaissance, laboratory testing revealed petroleum hydrocarbon levels up to 25,000 mg/kg. Field notes from the 1987 site visit indicate visible contamination in an area along the southern boundary of the empty-drum storage area that abuts the tank farm; this corresponds to the boundary line between Areas W and Z. An analysis of soil samples FS-2 and FS-4 (IRP Stage 3 field program) from this area showed TPHs concentrations of 830 and 840 mg/kg, respectively. Surface water samples FS-5, FS-6, and FS-7 from this area showed a range of TPHs concentrations of 1.0 to 3.0 mg/L. A hand-augered soil boring and an organic vapor meter at this location failed to detect either visible signs of contamination or hydrocarbon vapor. Area Y, contiguous with Areas W, X and Z, is thought to be contaminated by migration from these other areas.

5.5.1.2 Target Soil Cleanup Level. A cleanup level of 10,000 mg/kg has been selected for the Large Fuel Spill on the basis of two factors:

- A hazardous contamination remedial evaluation of the Large Fuel Spill site based on the California LUFT Manual, and
- An evaluation of the maximum attainable cleanup level at this Arctic location.

The California LUFT Manual specifies a cleanup level of 10,000 mg/kg in soil when these conditions are met:

- Distance to groundwater is greater than 100 feet
- Average annual precipitation is less than 10 inches
- No known manmade conduits are present to increase vertical migration of leachate, and

- No known unique site features such as a nearby recharge area, coarse soil or nearby wells are present.

Groundwater is an unreliable drinking water resource and is not used as a source at POW-1. The surface water lake that provides drinking water at POW-1 is located more than 1 mile from each of the sites. The terrain is essentially flat; therefore it is unlikely that site contaminants would reach the drinking water lake.

Bioremediation techniques in cold climates can achieve the 10,000 mg/kg target cleanup level. Bioremediation may be able to achieve a cleanup level of 5000 mg/kg or less. Achieving a lower cleanup level will be attempted at the Large Fuel Spill. If a cleanup level below 5000 mg/kg can be achieved at the Large Fuel Spill, then bioremediation of the TPHs contamination at the POW-1 POL Storage Area and the Old Sewage Outfall/Beach Tanks will also be attempted.

The applicable cleanup standard for TPHs in soil is the Alaska draft interim standard of 100 mg/kg. The remediation program will attempt to achieve this cleanup standard. Cleanup will continue as long as reductions of TPHs in soil are practically attainable.

5.5.1.3 Site Characteristics. POW-1 is set in a lowland section of coastal northern Alaska, characterized by broad floodplains and river deltas. A permafrost layer exists at a depth of about 2.5 feet below ground surface, based on hand-augered soil borings made in August 1988. The weather at the high northern latitude of the station allows a working window of about 3 months each year.

POW-1 is located on a low relief (20 feet) hill. Surface drainage in the immediate area of the Large Fuel Spill area is west and southwest toward wetlands, and then north to the Beaufort Sea. Subsurface drainage is controlled by permafrost that is a physical barrier to downward percola-

tion and acts as a confining layer. Infiltrating surface water and contaminants originating from surface or near-surface spills will tend to mound on top of the permafrost and move in the direction of lower hydraulic head toward the Beaufort Sea. The unconfined groundwater is generally fresh, but low volume, and frozen in winter. The slow rate of groundwater movement and seasonal freezing generally preclude its use as a drinking water source. Groundwater below permafrost has been tested in both the Barrow area to the west and near Umiat to the south. Depth to base of permafrost along the Beaufort Sea varies from 550 feet at Barrow to 1800 feet at Prudhoe Bay. Therefore, because neither near-surface nor deep groundwaters are potable, this FS will be limited to an assessment of remedial technologies applicable to soils. Groundwater and surface water remediation technologies will not be considered further.

Geologically, POW-1 is underlain by periglacial (glacial-margin) deposits and features that are locally covered by thin sandy beach deposits or fill imported during construction of base facilities and subsequent improvements. The landscape is dominated by thermokarst (depressions in the land surface overlying permafrost) topography, with many lakes oriented along a north-south axis. The fill material is composed of coarse-grained noncohesive soils that were used to construct building or staging pads. The underlying glacial deposits include a mixture of discontinuous clay, silt, sand and gravel horizons, and decaying organic material.

5.5.2 Preliminary Alternative Remedial Actions

The purpose of this section is to identify viable alternative remedial actions to abate the contamination at the Large Fuel Spill area.

5.5.2.1 General Response Actions. Table 5-3 is a listing of general response actions that could be used to remediate the identified contamination at the Large Fuel Spill area.

Table 5-3. GENERAL RESPONSE ACTIONS, LARGE FUEL SPILL FS

General Response Actions
No Action
Containment
Extraction/On-Site Treatment
Extraction/Off-Site Treatment
In Situ Treatment

5.5.2.2 Applicable Remedial Technologies. For each of the general response actions listed in Table 5-3, a list of potential remedial technologies has been identified which accomplish the response action. These potential technologies are presented in Table 5-4. In general, at least two potential remedial technologies have been identified for each general response action.

5.5.2.3 Initial Screening of Possible Remedial Technologies. Technologies selected here for screening represent the candidate methods considered most appropriate for containment or extraction and treatment of contaminated soil at the Large Fuel Spill area. The criteria used by WCC in the initial screening of technologies listed in Table 5-4 were site conditions, waste characteristics, technical feasibility, and logistics, especially as they are affected by the factors previously discussed in the introduction. Associated technologies for the remediation of contaminated soils listed in Table 5-4 are discussed according to types of general response action.

5.5.2.3.1 No Action/Institutional Controls. This alternative would include no remedial construction combined with a long-term monitoring program, since contamination would remain at the site. Periodic soil sampling and chemical testing would be done until the level of contamination was either clearly decreasing or was reduced below remediation levels due to natural biodegradation and dispersion. This alternative could also include fencing as an institutional control to prevent unauthorized site access. The time period for sampling and analysis would be annually for 5 years and then once every 5 years, until significant contamination is no longer detected in soils. Some natural biological degradation and dispersion of TPHs can be expected during the summer months. The no action/institutional controls alternative is considered further in this FS as a baseline comparison for other potential remedial soil technologies.

5.5.2.3.2 Containment/Long-Term Monitoring. Capping provides containment by reducing the likelihood of human and animal contact with the

Table 5-4. GENERAL RESPONSE ACTIONS AND ASSOCIATED TECHNOLOGIES FOR SOIL

General Response Action	Associated Technology
No Action/Institutional Controls	<ul style="list-style-type: none"> • Long-Term Monitoring • Fencing/Long-Term Monitoring
Containment	<ul style="list-style-type: none"> • Capping/Long-Term Monitoring
Extraction/On-site Treatment or Disposal	<p>Physical</p> <ul style="list-style-type: none"> • Excavation • Soil Washing • Fixation • Thermal Technologies • Landfill <p>Chemical</p> <ul style="list-style-type: none"> • Reagent Oxidization <p>Biological</p> <ul style="list-style-type: none"> • Landfarming
Extraction/Off-site Treatment or Disposal	<ul style="list-style-type: none"> • Excavation • Landfill • Reclamation • Incineration
In Situ Treatment	<p>Physical</p> <ul style="list-style-type: none"> • Vapor Extraction • Steam Extraction • Fixation • Soil Washing • Vitrification <p>Chemical</p> <ul style="list-style-type: none"> • Photolysis <p>Biological</p> <ul style="list-style-type: none"> • Enhanced Biodegradation

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contamination and reducing vertical and horizontal movement of the contaminants through the soil. Capping consists of covering the contaminated area with about 12 inches of locally available earth fill material. The purpose of reducing contact will be achieved by any earth material, but the reduction of contaminant movement will be more successful the finer the fill material. The use of capping initially requires action with cap construction, but becomes passive over time, except for periodic inspection and maintenance in the event of damage. This action minimizes the spread of contamination and protects human health and the environment. Containment/long-term monitoring is considered further in this FS.

5.5.2.3.3 Extraction/On-Site Treatment or Disposal.

Physical Methods/Excavation. Excavation is a common method of extracting contaminated soil using conventional earthmoving equipment. Depending on the amount of material and depth of excavation, different types of equipment can be used. Excavation methods are not affected by waste types or technical requirements at this site. However, weather conditions limit outdoor construction to 3 months per year. Excavation will impact undisturbed areas of native vegetation and could adversely affect the permafrost horizon. Excavation will remove contaminants, resulting in protection of human health and the environment. Excavated soils can be treated or disposed of on site. Excavation is further examined below in combination with various on-site remediation alternatives.

Physical Methods/Soil Washing. Soil washing technology involves flushing excavated contaminated soil with water containing surfactants that enhance removal of hydrophobic organics adsorbed onto soil particles. This technology relies heavily on materials handling and separation technology developed by the metals mining industry. The effectiveness of washing depends primarily on soil characteristics, contaminants, degree of mixing, and the surfactant effectiveness. Although soil washing has been used for soil contaminated with

organics, it is a relatively sophisticated and novel technology for a remote location. Soil washing is not evaluated further in this FS.

Physical Methods/Fixation. The use of fixation technology on contaminated soil involves either chemical fixation or cementing of contaminants to soil particles to reduce leaching potential. Fixation of metals has been applied commercially for several years, but its effectiveness on organic contaminants is not proven. For this reason, fixation will not be considered further in this FS.

Physical Methods/Thermal Technologies. Thermal technology may be applied to the POW-1 site contaminants either as destructive incineration or thermal treatment/volatilization for diesel-contaminated soils. Incineration is a higher temperature version of thermal treatment that is generally used to oxidize all molecular species to their theoretical limits at the temperature of the combustion chamber. Because thermal treatment can accomplish the same level of cleanup as incineration with diesel/jet fuel contamination, and is lower cost and simpler logistically, incineration will not be considered further in this FS. Low-temperature thermal treatment volatilizes the hydrocarbon contaminants from the soil matrix and captures them for disposal or reuse as fuel. Mobile thermal units are available. Use of on-site thermal treatment of contaminated soils is considered further in this FS.

Physical Methods/On-Site Landfill. An on-site landfill could be constructed to hold the contaminated materials. However, this alternative is complicated by technical and permitting issues. Siting a landfill in close proximity to the Beaufort Sea and where the water table is high may not be acceptable to permitting authorities or to the public. Siting studies and permitting are time consuming. For these reasons, the on-site landfill is not evaluated further in this FS.

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Chemical Methods/Reagent Oxidation. Oxidants, such as ozone and hydrogen peroxide, are capable of destroying organic contaminants in soil. However, these oxidizing agents are not selective and may react with other oxidizable material in the soil. Therefore, a large amount of the oxidant may be consumed by nontarget organic materials. This effect could increase chemical consumption significantly. Oxidation could also change the chemical balance of the soil if the soil is to be redeposited. Chemical oxidation may also produce byproducts that are more soluble and toxic than their parent compounds. For these reasons, reagent oxidation is not addressed further in this FS.

Biological Methods/Landfarming. Landfarming is a technology originally developed by the petroleum industry for oily wastes and soils. Landfarming involves the excavation of contaminated soils, aeration on an impermeable surface, and the addition of biologically important chemicals (nutrients, water) to enhance natural biological degradation. For very shallow contamination, soils may be treated in situ by irrigation, nutrient addition, and possibly rototilling. Landfarming is evaluated further in this FS because of its proven effectiveness.

5.5.2.3.4 Extraction/Off-Site Treatment and Disposal.

Excavation. Excavated soils can be treated or disposed of off site. This technology is further examined below in combination with various off-site remediation alternatives.

Disposal in Landfill. One off-site disposal option is disposal of the contaminated soils at a Class I landfill. The nearest Class I landfill is located in Oregon. Transportation options from the site to the nearest Class I landfill include charter air transport services or chartered barges. The barge is limited to travel during 1 to 2 summer months when the north slope sea lanes are open. Off-site landfilling is not considered further in this FS because of logistical problems and

the fact that on-site technologies can achieve the same results more cost-effectively.

Reclamation. A recently demonstrated reclamation technology uses hydrocarbon-contaminated soil as a raw material in producing hot-mix asphalt (HMA). Contaminated soil is used to supplement aggregate in a 5/95 proportion. The typical HMA process is modified by adding a ceramic cylinder which acts as a combustion chamber. The chamber is equipped with flights to enhance heat transfer and transport the soil through the chamber. Soil particle size constraints on use of this technology include limiting to 20 percent the proportion with a mesh size under 200. Large soil particles must also be screened or broken up. A more versatile approach using identical processing makes use of the decontaminated soil for road base. All soil particle sizes up to 1.5 inches in diameter may be used. HMA is produced on a limited basis due to weather constraints imposed by road construction. The only HMA plants currently operating are on the east coast of the continental United States. Because of the logistical problems of transporting the soil, reclamation is not evaluated further in this FS.

Incineration. Off-site incineration would involve on-site extraction of contaminated soil, and treatment physically located in the lower 48 states. For reasons cited above, including logistics and availability of on-site solutions, off-site incineration is not considered further in this FS.

5.5.2.3.5 In Situ Treatment. The use of in situ treatment technologies offers many advantages considering the remote location of POW-1 and possible damage to the tundra associated with using heavy excavation equipment. In situ technologies may be physical, chemical, or biological processes. The physical processes include vapor or steam extraction,

attenuation, fixation, soil washing, and vitrification. The only chemical process identified is photolysis. The only biological process identified is enhanced biodegradation.

Physical Methods/Vapor Extraction. In vapor extraction, a vacuum is applied to a grid of perforated extraction wells to remove the contaminant. Vapor extraction is applicable to contaminants with high vapor pressure, such as gasoline, and is less applicable to diesel and jet fuel. The low permeability of the native soils and shallow permafrost would restrict vapor movement and make well installation difficult. Vapor extraction is not considered further in this FS.

Physical Methods/Steam Extraction. Steam extraction is used to remove contaminants less volatile than those removable with vapor extraction. Steam is applied through a hollow shaft, the bottom of which is connected to a drill bit. The bit is used to induce complete mixing. Vapors are continually extracted, monitored, and scrubbed. Contaminants are captured using a condenser in combination with granular-activated carbon. The high-temperature injection of steam for this technology would adversely affect the permafrost layer. Also, this technology has not been used extensively to date and is considered experimental for use at this location. For these reasons, steam extraction is not considered further in this FS.

Physical Methods/Fixation. Fixation technology for in situ treatment is similar to aboveground fixation discussed earlier and involves the surface and subsurface introduction of a physical or chemical binder to the soil. Although use of this technology has been effective for inorganic contaminants, its effectiveness for organic contaminants has not been proven. Therefore, fixation is not considered further in this FS.

Physical Methods/Soil Washing. In situ soil washing technology uses the same principle as excavated soil washing, already discussed, except that the washing solution is applied to the soil in place, and then collected for treatment. Contaminated soil is washed with water containing surfactants. This washing enhances removal of hydrophobic organics adsorbed onto soil particles. The effectiveness of washing depends primarily upon soil characteristics, contaminants, degree of mixing, and surfactant effectiveness. In situ soil washing is technologically less proven than excavated soil washing. Degree of mixing is harder to control, and depth of mixing is limited. Hydraulic control on subsurface waters must be demonstrated to prevent inadvertent spreading of contamination. It is a sophisticated, novel technology. Soil washing will not be evaluated further in this FS.

Physical Methods/Vitrification. Vitrification is a high-temperature thermal process which partly volatilizes organics and partly immobilizes and solidifies the contaminated matrix into an inert, vitrified mass. Electrodes are implanted in the ground and an electric current is applied which vitrifies the soil. Due to the high temperature required to cause vitrification, damage to the permafrost layer would occur. For that reason, vitrification is not evaluated further in this FS.

Chemical Methods/Photolysis. The only identified in situ chemical technology to address soil contamination is photolysis. In this technology, photodegradation occurs when the contaminated soil is exposed to air and direct sunlight. This process can be enhanced by the introduction of proton donors. The typical method of treatment involves application of the proton donor, followed by tillage to expose the contaminated soil to sunlight. Considering the northerly location of the sites and the limited winter sunlight, it is doubtful that this technology will attain the goals of the remedial activities in a timely fashion. Therefore, photolysis is not considered further in this FS.

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Biological Methods/Enhanced Biodegradation. Techniques to encourage permanent restoration of the damaged areas can be implemented at POW-1. Studies to determine the area's native soil bacterial species and soil characteristics would be required. Careful enhancement of the natural biological elements would encourage degradation of petroleum products and eventual permanent restoration. Enhanced biodegradation is considered further in this FS.

5.5.3 Operable Units

Operable units are proposed to provide a logical division of site contamination problems. An operable unit is defined as a distinct action or set of actions that can be taken within the overall remedial action program and that effectively moves toward, but does not complete, or preclude, future site remediation activities.

The operable unit concept is applicable because of the nature of the contamination problem and, in general, the ability to separate remedial actions addressing each problem. A no action alternative and a number of distinct remedial actions are defined for each operable unit. The evaluation of each alternative within an operable unit assumes that there is no dependence upon the alternatives selected for other operable units. It is recognized that interrelationships between alternatives for the adjacent operable units at this site exist. These interrelationships must be considered in final selection of remedial technologies and detailed engineering of a remedial action plan for this site.

For the POW-1 Large Fuel Spill, two distinct operable units have been defined to address soil contamination at fill sites and at native tundra sites. The two operable units are the Fill Operable Unit (A) and the Tundra Operable Unit (B). The operable units are further subdivided into zones in Table 5-5 and on Figure 5-1 as a way of simplifying perimeter, area, and volume calculations. Alternatives within each operable unit are

numbered with the appropriate A and B letter following the number (i.e., 1A, 2A, 1B, 2B, etc). Refer to Table 5-5, Table 5-6, and Figure 5-1.

5.5.3.1 Fill Operable Unit (A). Sites in the Fill Operable Unit have been selected based on the nature of the existing soils. Various buildings, roads, and pads have been constructed at POW-1 to facilitate operations. In these areas, the native tundra has been covered with fill material. Native tundra adjacent to the fill has been disturbed by construction activities. Excavation activities to remove contamination could proceed without further damage to the native tundra. On Figure 5-1, Areas V and Z fall under the conditions defined for inclusion in the Fill Operable Unit.

5.5.3.2 Tundra Operable Unit (B). Sites in the Tundra Operable Unit have a native tundra groundcover. Although the Tundra Operable Unit, where it borders the Fill Operable Unit, has been disturbed by past activities, new vegetation has taken hold in the disturbed areas. Alternatives developed for this operable unit are designed to minimize further disruptions to the tundra. On Figure 5-1, Areas W, X, and Y are included in the Tundra Operable Unit.

5.5.4 Remedial Alternatives

The remedial alternatives that are considered for each operable unit in this FS are listed in Table 5-6. These alternatives were developed using the screened technologies found to be suitable for POW-1. The remedial alternatives for fill and native tundra have been assembled based on an initial screening of technologies focusing on feasibility, implementability and, at times, cost. In view of the small number of remedial alternatives identified, further initial screening of alternatives is not considered necessary. Criteria used for screening of technologies to develop the remedial alternatives are basically those identified in the USAFOEHL/TS Handbook. A detailed analysis of the remedial alternatives for each operable unit is presented below.

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Table 5-5. OPERABLE UNIT PARAMETERS, LARGE FUEL SPILL FS*

Zone Designation	Soil Type	Operable Unit	Perimeter (ft)	Area (sq ft)
FS-Z	Fill	Fill	875	48,000
FS-V	Fill	Fill	<u>775</u>	<u>14,000</u>
Subtotal: Fill Operable Unit			1650	62,000
FS-W	Tundra	Tundra	625	62,000
FS-X	Tundra	Tundra	750	33,000
FS-Y	Tundra	Tundra	<u>525</u>	<u>17,000</u>
Subtotal: Tundra Operable Unit			1900	72,000
TOTAL: Fill and Tundra Operable Units			<u>3550</u>	<u>134,000</u>

* See Figure 5.1 for a map of the Large Fuel Spill site.

Table 5-6. REMEDIAL ALTERNATIVES BY OPERABLE UNIT, LARGE FUEL SPILL FS 46 203

FILL OPERABLE UNIT

- 1A - No Action/Institutional Controls (Long-Term Monitoring)
- 2A - No Action/Institutional Controls (Fence and Monitor)
- 3A - Containment (Capping and Monitoring)
- 4A - Excavation/On-site Thermal Treatment
- 5A - Excavation/On-site Landfarming

TUNDRA OPERABLE UNIT

- 1B - No Action/Institutional Controls (Long-Term Monitoring)
 - 2B - No Action/Institutional Controls (Fence and Monitor)
 - 3B - In Situ Enhanced Biodegradation
 - 4B - Containment (Capping and Monitoring)
-

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5.5.5 Detailed Analysis of Remedial Alternatives

This section evaluates the remedial alternatives developed in the previous section, using criteria listed in the USAFOEHL/TS Handbook, Version 2.0, 1988. These criteria include:

- Compliance with cleanup standards
- Protection of human health and the environment
- Technical feasibility
- Implementation logistics
- Reduction of toxicity, mobility, or volume through treatment
- Long-term effectiveness
- Institutional requirements
- Cost.

For each remedial alternative, a process description, cost estimate, and noncost evaluation is presented. The process description lists the steps required to implement each alternative. For each alternative technology, a cost analysis is presented in tabular form using a 1989 basis. The evaluation summary is also presented in tabular form, discussing the noncost criteria listed above. Section 5.5.6 compares the alternatives in terms of the evaluation criteria and cost. A summary of remedial alternatives costs is presented in Table 5-7.

The accuracy of the cost estimates is linked to the accuracy of the contaminated soil estimate. If the contaminated area and/or volume is different from what is used in this FS, the implementation cost of the alternative would also change.

5.5.5.1 Alternative 1A - No Action/Institutional Controls (Long-Term Monitoring). This alternative consists of leaving the site in its current condition and instituting a long-term soil monitoring program to measure contaminant concentrations. Natural hydrocarbon degradation by biological activity is expected to occur over time. Monitoring would continue as long as contaminant levels exceed the target level.

Table 5-7. SUMMARY OF REMEDIAL ALTERNATIVE COSTS, LARGE FUEL SPILL FS

Alternative	Cost
1A - No Action/Institutional Controls (Long-Term Monitoring)	\$ 73,000
2A - No Action/Institutional Controls (Fence and Monitor)	\$ 214,000
3A - Containment (Capping and Monitoring)	\$ 138,000
4A - Excavation/On-site Thermal Treatment	\$1,069,000
5A - Excavation/On-site Landfarming	\$ 104,000
1B - No Action/Institutional Controls (Long-Term Monitoring)	\$ 73,000
2B - No Action/Institutional Controls (Fence and Monitor)	\$ 280,000
3B - In Situ Enhanced Biodegradation	\$ 90,000
4B - Containment (Capping and Monitoring)	\$ 153,000

Note: Costs are rounded to the nearest \$ thousand. These costs are presented as January 1989 dollars. Effects of inflation are not included.

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The monitoring program would consist of soil sampling and analysis on a periodic basis, every year for the first 5 years and then once every 5 years, until either a significant drop in contaminant concentration has been reported or the cleanup goal has been attained. Four samples would be collected during each sampling event and sent to a laboratory for TPHs analysis.

A cost estimate for Alternative 1A is shown in Table 5-8. The cost estimate is based on a 30-year monitoring period, based on CERCLA/SARA guidelines. A discussion of this alternative in terms of "Evaluation Criteria" specified in the USAFOEHL/TS Handbook, Version 2.0, 1988 is presented in Table 5-9.

5.5.5.2 Alternative 2A - No Action/Institutional Controls (Fence and Monitor). This alternative consists of fencing the contaminated site to deter people and animals from entering. Since contamination would remain, the site would be subject to long-term soil monitoring to determine remaining concentration of contaminants. Natural degradation of hydrocarbons is expected to occur slowly due to the short summer season where the average high temperature is approximately 40°F. Drawbacks to fencing include the tendency for damage due to both ice buildup and windblown snow loading.

Materials sufficient to install 900 linear feet of fence would be purchased in Anchorage and transported to Prudhoe Bay on three flatbed trucks. From Prudhoe Bay the trucks would travel via cat-train or barge to POW-1. Labor and some equipment would come from Prudhoe Bay. Other loading and transport equipment can be rented from the contract operator at POW-1. Room and board is available at POW-1.

A cost estimate for Alternative 2A is shown in Table 5-10. A discussion of this alternative in terms of the "Evaluation Criteria"

Table 5-8. COST SUMMARY FOR ALTERNATIVE 1A - NO ACTION/LONG-TERM MONITORING ACTIVITIES

Item	Quantity	Rate	Total
Labor			
Field Sampling	40 hr	\$ 85/hr	\$3,400
Report Preparation	30 hr	\$110/hr	3,300
Contractor Per Diem and Transportation			2,000
Materials			400
Lab Analysis			
TPHs	4 samples + 1 travel blank	\$75/sample	375
Sample Shipment	1 cooler	\$120/sample	<u>120</u>
Total per Sampling Event			\$9,595
Present Worth of Monitoring Costs* (30-year program, 5% discount rate)			\$60,712
Subtotal Monitoring Costs			\$60,712
Contingency (20% of Monitoring Costs)			\$12,142
Total Monitoring Costs			≈\$72,900

* Costs are based on sampling annually for the first 5 years, and then once every 5 years for the next 25 years.

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Table 5-9. EVALUATION CRITERIA FOR ALTERNATIVE 1A - NO ACTION/LONG-TERM MONITORING

Compliance with Cleanup Standards	This alternative does not meet the proposed cleanup standard for TPHs in soil.
Protection of Human Health and the Environment	Human access and access by large wildlife would not be deterred. No mitigation of the environment occurs.
Technical Feasibility	Feasible
Implementability/Logistics	Readily implementable.
Reduction of Toxicity, Mobility, or Volume through Treatment	No reduction of toxicity, mobility, or volume of contaminants would occur as a result of this remedial alternative.
Long-Term Effectiveness	The time required for natural degradation of TPH contaminants cannot be predicted.
Institutional Requirements	None

Table 5-10. COST SUMMARY FOR ALTERNATIVE 2A - NO ACTION/FENCE AND MONITOR

Item	Quantity	Unit Rate	Total \$
Labor			
Fence installation	900 feet	\$60/foot	\$54,000
Room and Board			
Room 4 persons x 10 days = 80 person days	80	\$26.50/day	2,120
Board 4 persons x 10 days = 80 person days	80	\$35.50/day	2,840
Transportation			
Fence: Anchorage to POW-1	3 flatbeds	\$12,500 ea	37,500
Personnel: from Prudhoe Bay	4 persons	\$ 700 ea	2,800
Material			
(900 linear feet of chain link fence - 18X50-foot rolls	900 feet	\$20/foot	18,000
Monitoring Costs			
30-year program in 1989 dollars at a 5% discount rate (see Table 5-8)			<u>60,712</u>
SUBTOTAL			\$177,972
20% CONTINGENCY			<u>35,594</u>
TOTAL			≈\$213,600

specified in the USAFOEHL/TS Handbook is presented in Table 5-11. The Alternative 2A monitoring program will be identical to that described in Alternative 1A.

5.5.5.3 Alternative 3A - Containment (Capping and Monitoring). This alternative would involve placing and compacting 12 inches of local earth fill on top of the existing pad. If different fill materials are available, the finest material will be used. Since contamination would remain, the site would be subject to long-term soil monitoring to determine if the concentration of contaminants falls below proposed cleanup levels. Natural degradation of hydrocarbons is expected to occur slowly as described under Alternative 2A.

To implement capping, earthmoving equipment and operators are available for hire from the contract operator of POW-1. Labor would be contracted from Prudhoe Bay and flown to the site by a commercial carrier that flies between Prudhoe Bay and Barrow, landing at POW-1 on request.

Gravel, normally a scarce resource on the north slope, may be obtained locally from the beach at Point Lonely AFS if the proper permits can be obtained. Initial inquiries with the United States Bureau of Land Management (BLM) indicate this is a possibility. Cost estimates shown in Table 5-12 are based on the assumption of procuring a local gravel source at a nominal interagency cost.

Table 5-12 summarizes the costs associated with this alternative, and Table 5-13 outlines the evaluation.

5.5.5.4 Alternative 4A - Excavation/On-Site Thermal Treatment. This alternative consists of six major steps: mobilization of the thermal treatment unit, equipment setup, excavation of the soil, treatment, soil replacement, and demobilization. The equipment comes partially disassembled on five separate trailers. Approximately 1 week is required

Table 5-11. EVALUATION CRITERIA SUMMARY FOR ALTERNATIVE 2A -
NO ACTION/FENCE AND MONITOR

Compliance with Cleanup Standards	This alternative does not meet the proposed cleanup standard for TPHs in soil.
Protection of Human Health and the Environment	Human access and access of large wildlife would be deterred by fencing, but no mitigation of impact to the environment occurs.
Technical Feasibility	Feasible
Implementability/ Logistics	Material is not available locally. Equipment required is available at the site.
Reduction of Toxicity, Mobility, or Volume through Treatment	No reduction of toxicity, mobility, or volume of contaminants would occur as a result of this remedial alternative.
Long-term Effectiveness	The time required for natural degradation of TPHs contaminants cannot be predicted.
Institutional Requirements	None

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Table 5-12. COST SUMMARY FOR ALTERNATIVE 3A - CONTAINMENT
(CAPPING AND MONITORING)

Item	Quantity	Unit Rate	\$ Total
Equipment Rental (12 hours/day)			
Loader	24 hours	\$42.25/hr	1,014
Dump truck	24 hours	\$46.50/hr	1,116
Pickup truck (supervisor)	2 days	\$50	100
Compacting loader (3 hr/day)	6 hours	\$42.25/hr	254
Operators	40 hours	\$60/hr	2,400
Fuel - dump truck and loader	60 hours	\$50/hr	3,000
Fuel - pickup	5 days	\$20/day	100
Fuel - compacting loader	15 hours	\$50/hr	750
Gravel Cap	2300 cu yds	\$20	46,000
Monitoring Costs (30-year program in 1989 dollars at a 5% discount rate)			<u>60,712</u>
SUBTOTAL			\$115,446
20% CONTINGENCY			<u>23,089</u>
TOTAL			≈\$138,350

Table 5-13. EVALUATION CRITERIA SUMMARY FOR ALTERNATIVE 3A -
CONTAINMENT (CAPPING AND MONITORING)

Compliance with Cleanup Standards	This alternative does not meet the proposed cleanup standard for TPHs in soil.
Protection of Human Health and the Environment	Human and wildlife access would be deterred by a cap over the contaminated area.
Technical Feasibility	Routine construction
Implementability/Logistics	Routine construction
Reduction of Toxicity, Mobility, or Volume through Treatment	No toxicity, mobility, or volume reduction because no treatment occurs with this alternative.
Long-Term Effectiveness	The time required for natural degradation of TPHs cannot be predicted.
Institutional Requirements for Implementation of Remedial Alternative	Permits may be required from BLM, EPA, State, and the North Slope Bureau.

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to assemble the unit. Operating personnel are supplied with the unit and would be responsible for assembly. The unit requires propane gas fuel, 460 volt 3-phase power, and a 10-gpm water supply. The cost for treatment includes air pollution control equipment.

The contaminated soil would be excavated using operators and equipment rented from the contract operator of POW-1. A gas chromatograph would be used on site to screen soil samples and guide the excavation work. A contract supervisor will oversee the excavation work and operate the gas chromatograph.

The excavated material would be fed into the low temperature thermal treatment unit at a rate of $7\frac{1}{2}$ tons per hour, 24 hours per day. Using volume data in Table 5-6 and an estimate of $1\frac{1}{2}$ tons/cubic yard for the fill material, it will take about 32 days to process all the contaminated fill. After treatment, the treated soil would be placed back into the excavation and the equipment would be disassembled for shipment back to Seattle.

The cost estimate for this alternative is presented in Table 5-14. It is likely that competitive bidding could lower the price substantially. Preliminary information from another vendor suggested pricing 50 percent lower than costs presented in this FS. A discussion of noncost evaluation criteria for this alternative is found in Table 5-15.

5.5.5.5 Alternative 5A - On-Site Landfarming. On-site landfarming would take place at the storage pad adjacent to the Husky tanks, the location of the contaminated fill (Figure 5-1). Landfarming would consist of turning the contaminated soil every two weeks throughout the summer to expose it to the atmosphere. By adding water, emulsification agents, and inorganic nutrients, landfarming enhances natural biodegradation and volatilization of hydrocarbons. The fill would be turned to a depth of 2 to $2\frac{1}{2}$ feet using a backhoe and rototiller. These activities would continue through the

Table 5-14. COST SUMMARY FOR ALTERNATIVE 4A - EXCAVATION/ON-SITE THERMAL TREATMENT

Item	Quantity	Unit Rate	Total \$
Labor			
Supervisor	600 hrs	\$85/hr	51,000
Equipment			
Backhoe for excavation (includes operator)	600 hrs	\$150/hr	90,000
LTTS mob/demob			85,000
LTTS stand by	1 week	\$19,000/week	19,000
GC for excavation confirmation sampling	30 days	\$250/day	7,500
Treatment Costs (includes operating labor, per diem, on-site analysis of treated waste)	4,400 yd ³	\$120/yd ³	528,000
Transportation Costs			
LTTS barged from Seattle to Point Lonely AFS (5 trailers)	1 roundtrip	\$45,000/way	90,000
Sample Shipment, Point Lonely AFS to RMAL	2 coolers	\$120/cooler	240
Contractor Per Diem and Transportation	30 days		17,700
Lab Analysis			
TPHs	32 samples	\$75/sample	2,400
SUBTOTAL			\$ 890,840
20% CONTINGENCY			178,168
TOTAL			\$1,069,000

RMAL - Rocky Mountain Analytic Laboratory
 LTTS - Low Temperature Thermal Treatment Unit
 GC - Gas Chromatograph

Table 5-15. EVALUATION CRITERIA SUMMARY FOR ALTERNATIVE 4A -
EXCAVATION/ON-SITE THERMAL TREATMENT

Compliance with Cleanup Standards	This alternative will meet the proposed cleanup standard for TPHs in soil.
Protection of Human Health and the Environment	TPHs contamination would be reduced in the soil by volatilization.
Technical Feasibility	Low temperature thermal treatment units are not subject to stringent operating condition requirements since they only need to volatilize contaminants, not destroy them. Thermal treatment is a proven technology in the hazardous waste treatment field.
Implementability/Logistics	Thermal treatment unit must be barged from Seattle. Scope of equipment provided, treatment rate and setup/breakdown time are dependent on the thermal treatment vendor selected.
Reduction of Toxicity, Mobility, or Volume through Treatment	This alternative reduces the toxicity, mobility, and volume of the TPHs contaminants in the soil. Concentrations of TPHs below proposed cleanup levels would remain in the soil at the site.
Long-term Effectiveness	The contaminants above proposed cleanup criteria would be removed from the site permanently.
Institutional Requirements	Air emissions from the thermal treatment unit are subject to regulation.

summer. Imported contract labor would be used. Supervising contract personnel would be required to oversee excavation and initial treatment.

At the end of summer, the fill would be statistically sampled to evaluate cleanup progress. Four samples per sampling event will be taken. If contaminant levels have not declined below the target level, the treatment will be continued the following years until the target level is obtained. At that time the fill would be leveled and compacted with a compacting loader, and the area placed back in service for storage.

Treatment effectiveness is anticipated to be high due to contaminant loss through volatilization and biodegradation. Aeration (through rototilling) would enhance both forms of contaminant loss, while nutrient supplementation and addition of emulsifier would enhance biodegradation in the contaminated soil. Treatment could be satisfactory in as little as 1 summer, although for cost-estimating purposes, it is assumed that 2 full summers would be necessary.

Table 5-16 summarizes the anticipated costs associated with on-site landfarming, and Table 5-17 summarizes the evaluation criteria for this alternative.

5.5.5.6 Alternative 1B - No Action/Institutional Controls (Long-Term Monitoring). This alternative involves no action to reduce contaminant levels or prevent access to the site. It is based on the principle that any action on native tundra lacking signs of vegetative stress is undesirable. Since contamination would remain, the site would be subject to long-term soil monitoring to determine if the concentration of contaminants falls below proposed cleanup levels. Natural degradation of hydrocarbons is expected to occur, as discussed above. Drawbacks to this alternative include the possibility of contact with hydrocarbon-contaminated soil and surface water by humans or animals. Costs for Alternative 1B are shown in Table 5-18. The evaluation criteria are summarized by Table 5-19.

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Table 5-16. COST SUMMARY FOR ALTERNATIVE 5A - EXCAVATION/ON-SITE LANDFARMING

Item	Quantity	Unit Rate	Total \$
Labor			
Soil treatment	104 hrs	\$50/hr	5,200
Monitoring and data analysis (4 samples per year)	16 hrs	\$85/hr	1,360
Excavation confirmation sampling	80 hrs	\$85/hr	6,800
Equipment Rental			
Backhoe for excavation	20 hrs	\$150/hr	3,000
Dumptruck for hauling (use two)	32 hrs	\$165/hr	5,280
Bulldozer for spreading	27 hrs	\$120/hr	3,240
Rototiller for treatment	96 hrs	\$75/hr	7,200
G.C. for confirmation sampling	2 day	\$1,500/day	3,000
Transportation			
Sample shipment	3 coolers	\$120/cooler	360
Contractor Per Diem and Transportation			
Excavation confirmation sampling			4,500
End-of-year sampling			720
Material			
Treatment supplies			3,000
Demob expenses			200
Analysis (TPHs)			
End-of-year sampling	4 samples	\$75/sample	300
Excavation confirmation sampling (16 samples)	32 samples	\$75/sample	<u>2,400</u>
SUBTOTAL FOR ONE YEAR			46,560
PRESENT WORTH OF CONSTRUCTION AND OPERATING COSTS (two years, 5% discount rate)			\$86,555
20% CONTINGENCY			<u>17,311</u>
TOTAL			≈\$103,900

RMAL - Rocky Mountain Analytic Laboratory
GC - Gas Chromatograph

Table 5-17. EVALUATION CRITERIA SUMMARY FOR ALTERNATIVE 5A -
EXCAVATION/ON-SITE LANDFARMING

Compliance with Cleanup Standards	This alternative complies with the cleanup standards for TPHs in soils.
Protection of Human Health and the Environment	Protection of human health and the environment is achieved when degradation below cleanup levels occurs.
Technical Feasibility	Petroleum products have been degraded successfully, even in cool climates. However, duration of remediation will be longer than in a temperate region.
Implementability/ Logistics	Major equipment and machinery required are available locally.
Reduction of Toxicity, Mobility, or Volume through Treatment	Reduction in toxicity and volume; mobility enhanced when TPHs volatilized. Low levels of TPHs below cleanup levels may remain in backfilled soils.
Long-term Effectiveness	Effective: contaminants eliminated by volatilization and microbial metabolism. Residual TPHs potentially less mobile, since organic material created by microbial action may bind the contaminants.
Institutional Requirements	Air permit may be required, because some contaminants will be volatilized during rototilling operation.

Table 5-18. COST SUMMARY FOR ALTERNATIVE 1B -
NO ACTION/INSTITUTIONAL CONTROLS (LONG-TERM MONITORING)

The details and estimated costs of this alternative are the same as those of Alternative 1A; i.e., present worth cost of 30-year monitoring program, \$73,000.

Table 5-19. EVALUATION CRITERIA SUMMARY FOR ALTERNATIVE 1B -
NO ACTION/INSTITUTIONAL CONTROLS (LONG-TERM MONITORING)

Compliance with Cleanup Standards	This alternative does not meet the proposed cleanup standard for TPHs in soil.
Protection of Human Health and the Environment	Human access and access by large wildlife would not be deterred. Native tundra would be preserved. No mitigation of the environment occurs.
Technical Feasibility	Feasible
Implementability/Logistics	Readily Implementable
Reduction of Toxicity, Mobility, or Volume through Treatment	No reduction of toxicity, mobility, or volume of contaminants would occur as a result of this remedial alternative.
Long-Term Effectiveness	The time required for natural degradation of TPHs cannot be predicted.
Institutional Requirements	None

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5.5.5.7 Alternative 2B - No Action/Institutional Controls (Fence and Monitor). This alternative consists of fencing the contaminated sites to deter people and animals from entering. Since contamination would remain, the site would be subject to long-term soil monitoring as discussed above under Alternative 1B. Drawbacks to fencing include the tendency for damage due to both ice buildup and windblown snow loading. Materials sufficient to install 1900 linear feet of fence would be obtained as described in Alternative 2A. The monitoring program consists of soil sampling and analysis as described under Alternative 2A.

A cost estimate for Alternative 2B is shown in Table 5-20 and the evaluation criteria are summarized in Table 5-21.

5.5.5.8 Alternative 3B - In Situ Enhanced Biodegradation. This alternative includes the following activities: the contaminated area will be visited on a biweekly basis during the summer season, and a dilute solution of emulsifier and inorganic nutrients will be applied. The soil treatment will be done using imported contract labor. Supervising personnel will be required to oversee the first treatment application. A tank truck containing water from the nearby lake will fill a series of water tanks containing the additives. The nutrient/emulsifier solution will then be sprayed using a pump and hose system. Irrigation activities will only wet the affected soils, not saturate them.

At the end of the summer, the effectiveness of the first summer of treatment in this area will be assessed by performing a statistically designed sampling program where soil samples will be collected and analyzed for TPHs. Four samples will be analyzed per sampling event. Observations of revegetation progress will also be recorded. Treatment in the area would continue each summer as long as the TPHs concentration continued to decline.

Table 5-20. COST SUMMARY FOR ALTERNATIVE 2B - NO ACTION/FENCE AND MONITOR

Item	Quantity	Unit Rate *	Total \$
Labor			
Fence installation	1600 feet	\$60/ft	\$96,000
Room and Board			
Room 4 persons x 16 days+ 64 person-days	64	\$26.50/day	1,696
Board 4 persons x 16 days 64 person-days	64	\$35.50/day	2,272
Transportation			
Fence: Anchorage to POW-1	3 flatbeds	\$12,500 ea.	37,500
Personnel: from Prudhoe Bay	4 persons	\$ 700 ea.	2,800
Material			
1600 linear feet of chain link fence	1600 LF	\$20/LF	32,000
Monitoring Costs			
30-year program in 1989 dollars at a 5% discount rate			<u>60,712</u>
	SUBTOTAL		\$232,980
20% CONTINGENCY			<u>46,596</u>
	TOTAL		<u>≈\$279,600</u>

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Table 5-21. EVALUATION CRITERIA SUMMARY FOR ALTERNATIVE 2B -
NO ACTION/FENCE AND MONITOR

Compliance with Cleanup Standards	This alternative does not meet the proposed cleanup standard for TPHs in soil.
Protection of Human Health and the Environment	Human and large wildlife access would be deterred by fencing, but no mitigation of impact to the environment occurs.
Technical Feasibility	Feasible
Implementability/ Logistics	Material is not available locally. Equipment required is available at the site.
Reduction of Toxicity, Mobility, or Volume through Treatment	No reduction of toxicity, mobility, or volume of contaminants would occur as a result of this remedial alternative.
Long-term Effectiveness	The time required for natural degradation of TPHs contaminants cannot be predicted.
Institutional Requirements	None

Treatment effectiveness is difficult to predict. Since the treatment is applied to the surface of the tundra, subsurface contamination may persist for extended periods because this treatment approach is not very effective in enhancing subsurface microbiological activities. In the cost analysis, it is assumed that 5 years of treatment will be necessary to restore this area.

Table 5-22 summarizes the costs associated with Alternative 3B. Table 5-23 summarizes the criteria evaluation for the alternative.

5.5.5.9 Alternative 4B - Containment (Capping and Monitoring). The implementation of this alternative would be as described in Alternative 3A. One exception is that the average fill thickness is expected to be 15 inches, to account for the roughness of the terrain. Table 5-24 summarizes the costs associated with this alternative. Table 5-25 summarizes the evaluation criteria.

5.5.6 Comparison of Remedial Alternatives

In this section, the remedial alternatives for each operable unit are compared on the basis of technical, environmental, human health, institutional, and economic analyses outlined in the USAFOEHL/TS Handbook. This section summarizes information presented earlier in this chapter for each alternative. A summary of remedial alternative costs is presented in Table 5-7.

5.5.6.1 Fill Operable Unit.

5.5.6.1.1 Technical Analysis. The order of technical feasibility and implementability for this operable unit, from most to least favorable, is 1A (No Action/Long-Term Monitoring), 3A (Capping), 5A (Excavation/Land-farming), 2A (Fencing), and 4A (Excavation/ Thermal Treatment). Alternative 1A (No Action/Long-Term Monitoring) is the most easily implemented because the logistics are not demanding and laboratory analysis is performed off site.

Table 5-22. COST SUMMARY FOR ALTERNATIVE 3B - IN SITU ENHANCED
BIODEGRADATION

Item	Quantity	Unit Rate	Total
Recurring Yearly Costs			
Labor			
Soil Treatment (2 persons)	80 hours	\$60/hr	\$4,800
End of Year Sampling (2 persons)	16 hours	\$85/hr	1,360
Equipment Rental			
Water Tank Truck	40 hours	\$50/hr	2,000
Transportation			
Sample shipment	1 cooler	\$120 cooler	120
Contractor Per Diem and Transportation (once per year for sampling from Anchorage)			
			775
Contractor visit, oversight of soil treatment ($\frac{1}{2}$ week, transportation, per diem, and labor charges)			
			5,475
Expense for supplies (Portable pool, hoses and pumps)			
			1,200
Materials			
Treatment chemicals			1,000
Lab Analysis (TPHs)	4 samples	\$75/sample	300
SUBTOTAL FOR ONE YEAR			\$17,010
PRESENT WORTH OF CONSTRUCTION AND OPERATING COSTS (5 years, 5% discount rate)			74,708
20% CONTINGENCY			14,942
TOTAL			≈\$89,600

Table 5-23. EVALUATION CRITERIA SUMMARY FOR ALTERNATIVE 3B - IN SITU
ENHANCED BIODEGRADATION

Compliance with Cleanup Standards	If effectively applied, this alternative meets proposed cleanup standards for TPHs in soils.
Protection of Human Health and the Environment	Protective of human health, minimal impact to permafrost occurs during treatment. Protection of the environment is achieved when degradation below cleanup levels occurs.
Technical Feasibility	Petroleum products have been degraded successfully, even in cool climates. However, duration of remediation may be longer than required in a temperate region.
Implementability/Logistics	Minimal equipment and chemicals are required for this technology.
Reduction of Toxicity, Mobility, or Volume through Treatment	Reduction in toxicity and volume; mobility may be enhanced by irrigation. Low levels of TPHs below cleanup level may remain in soils.
Long-term Effectiveness	If effective, contaminants would be destroyed by microbial metabolism. Residual TPHs are potentially less mobile, since organic material created by microbial action may bind the contaminants. Duration is uncertain.
Institutional Requirements	None

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Table 5-24. COST SUMMARY FOR ALTERNATIVE 4B - CONTAINMENT
(CAPPING AND MONITORING)

Item	Quantity	Unit Rate	\$ Total
Gravel Cap	3300 cu yds	\$20	66,000
Monitoring Costs (30-year program in 1989 dollars at a 5% discount rate)			<u>60,712</u>
SUBTOTAL			\$126,712
20% CONTINGENCY			<u>25,342</u>
TOTAL			≈\$152,050

Table 5-25. EVALUATION CRITERIA SUMMARY FOR ALTERNATIVE 4B -
CONTAINMENT (CAPPING AND MONITORING)

Compliance with Cleanup Standards	This alternative does not meet the proposed cleanup standard for TPHs in soil.
Protection of Human Health and the Environment	Human and wildlife access would be deterred by a cap over the contaminated area. Placing the cap would destroy native tundra and possibly disturb adjacent areas of native tundra.
Technical Feasibility	Routine construction
Implementability/Logistics	Routine construction
Reduction of Toxicity, Mobility, or Volume through Treatment	No toxicity, mobility, or volume reduction because no soil treatment is provided in this alternative.
Long-Term Effectiveness	The time required for natural degradation of TPHs cannot be predicted.
Institutional Requirements for Implementation of Remedial Alternative	Permits may be required from BLM, EPA, State, and the North Slope Bureau.

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Alternatives 3A (Capping) and 5A (Excavation/Landfarming) can be done with mostly local materials and locally available equipment. Landfarming of TPHs-contaminated materials has been done for many years.

Alternative 4A (Excavation/Thermal Treatment) would involve shipment of the thermal treatment unit to the site, a major transportation effort. The basic technology for volatilizing the hydrocarbons is proven and is not affected by site conditions.

5.5.6.1.2 Environmental and Human Health Analysis. Alternatives 4A (Excavation/Thermal Treatment) and 5A (Excavation/Landfarming) are expected to meet the proposed cleanup standard for TPHs in soil. Alternative 5A (Excavation/Landfarming) would probably reduce TPHs contaminants in the soil within 2 years. No adverse environmental effects are expected from these treatments as long as excavated areas are backfilled with soil immediately to prevent thawing of the permafrost layer.

Alternatives 1A (No Action), 2A (Fencing), and 3A (Capping) do not meet the proposed cleanup standards for TPHs in soil. Diesel fuel spills may persist for several decades in cold climates (McKendrick et. al. 1981). The actual length of time required to reach the target cleanup level is not known. Alternative 2A (Fencing) would deter entry to the contaminated sites with fencing. Alternative 3A (Capping) would prevent contact with the TPHs-contaminated soil and also slow the vertical migration of contaminants by reducing infiltration of surface water as long as the cap remained intact.

5.5.6.1.3 Institutional Analysis. Alternative 4A (Excavation/Thermal Treatment) and possibly Alternative 5A (Land farming) would require a permit for air discharges. Alternative 3A (Capping) would require gravel mining permits.

5.5.6.1.4 Economic Analysis. In this operable unit, the least costly treatments were found to be Alternatives 5A (Excavation/Landfarming) and 1A (No Action). The relatively high costs of Alternatives 3A (Capping) and 2A (Fencing) are due to the long-term monitoring program and the high cost of fence installation in permafrost. The major costs of Alternative 4A (Excavation/Thermal Treatment) are high equipment shipping charges to this remote site and high unit costs to treat soil.

For all alternatives except 1A (No Action), the accuracy of the cost estimate is linked to the accuracy of the contaminated soil estimate. If the contaminated volume (or area) is found to be different than that used in this FS, the implementation cost of the alternatives would also change. For Alternative 1A (No Action), the largest cost is for the long-term monitoring program, which is not affected by a change in contaminated soil volume.

5.5.6.2 Tundra Operable Unit.

5.5.6.2.1 Technical Analysis. The order of technical feasibility and implementability for this operable unit, from most to least favorable, is 1B (No Action), 4B (Capping), 3B (In Situ Enhanced Biodegradation), and 2B (Fence and Monitor). Alternative 1B (No Action) is the most implementable.

Alternative 4B (Capping and Monitoring) was discussed above under Alternative 3A. Alternative 3B (In Situ Enhanced Biodegradation) would not be difficult to implement. The biological degradation of TPHs contaminants is well documented in the continental U.S. Biodegradation of TPHs at the site is expected to be slower due to cold weather.

5.5.6.2.2 Environmental and Human Health Analysis. As was discussed earlier in this report, disruptive activities at sites where native tundra vegetation occurs would not be desirable remedial alternatives. Alternative 4B (Capping) would destroy native tundra and, therefore, is not a desirable alternative. Alternatives 1B (No Action) and 2B (Fence and

Monitor), as well as Alternative 4B (Capping), would not meet the proposed cleanup levels. Although some natural biodegradation of the TPHs contaminants would occur, arctic studies of diesel fuel spills have shown that these spills have persisted for several decades. Fencing at the site would discourage entry of people and wildlife, thus reducing the chance of contact with the contaminated material. Capping would effectively prevent access to the contaminated material.

Alternative 3B (In Situ Enhanced Biodegradation) would act to reduce contaminant levels gradually without further disrupting the native vegetation which already appears to be recovering.

5.5.6.2.3 Institutional Analysis. The Alaska State Historic Preservation Officer (SHPO) has determined that the Alaska DEW Line stations are historically significant, and SHPO has made a preliminary determination that the stations are eligible for the National Register of Historic Places. Consultation with SHPO would be appropriate before any alterations on the manmade environment are performed for hazardous waste cleanup. Institutional issues that may affect implementation of the alternatives developed for this operable unit include permitting requirements for gravel mining and for volatile air emissions.

5.5.6.2.4 Economic Analysis. Of the two alternatives identified for treatment of the Tundra Operable Unit, Alternative 1B (No Action) and Alternative 3B (In Situ Enhanced Biodegradation) were found to be almost equal in cost.

For Alternative 3B (In Situ Enhanced Biodegradation), the accuracy of the cost estimate is linked to the accuracy of the contaminated soil estimate. If the contaminated volume is found to be larger than estimated here, the implementation cost of the alternative would increase. Alternative 1B (No Action) is not affected by a change in soil volume.

Alternative 2B (Fence and Monitor) is most expensive due to the difficulty of installing fence in permafrost. Alternative 4B (Capping) is intermediate in cost.

Recommendations are presented in Section 6.4.3.

6.0 RECOMMENDATIONS

6.1 INTRODUCTION

This section describes the recommended direction and approach for future IRP efforts for the three USAF stations discussed in this report: Barter Island (BAR-M), Bullen Point (POW-3), and Point Lonely (POW-1). The recommendations for each station and each operable unit within a station are categorized per the USAFOEHL/TS Handbook recommendation category description. These categories are:

Category 1: Stations/operable units where no further IRP action is required. Existing data are sufficient to assess that conditions at the site have no significant impact on human health or the environment. Separate Technical Documents to Support No Further Action (TDSNFAs) will be developed and submitted for these stations/operable units.

Category 2: Stations/operable units requiring additional field investigations to determine mobility, toxicity, and volume of contaminants; evaluate human health and environmental risks associated with each contaminant; or conduct a detailed evaluation of remedial alternatives.

Category 3: Stations/operable units where the FS process has been completed. Rationale for selecting each recommended alternative is included. Separate Technical Documents to Support Remedial Action Alternatives (TDSRAAs) will be developed and submitted for these stations/operable units.

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IRMs are included in Category 1 because additional IRP studies are not required; the site has been adequately characterized for the IRP program. Nevertheless, simple construction/removal measures are considered to achieve timely remediation of some potential environmental problems. The potential problems and remedies are not significant enough to require a full FS, and therefore, IRMs are discussed under Category 1.

The applicable categories, recommendations, and rationales are discussed for each station/operable unit in Sections 6.2, 6.3, and 6.4 below.

6.2 BARTER ISLAND AFS (BAR-M)

6.2.1 Category 1 Sites

No further action is needed based on the qualitative risk assessment at BAR-M Sites 1, 2, 3, 4, 8, 9, and 12. A BAR-M TDSNFA will be prepared and submitted as a separate document for these sites. The BAR-M Category 1 sites are Old Landfill (Site 1), Sewage Lagoon (Site 2), POL Catchment Area (Site 3), New Landfill (Site 4), Contaminated Ditch (Site 8), Old Dump Site N.W. (Site 9), and Old Airport Dump (Site 12).

To remedy potential environmental problems, IRMs were considered at three of these sites and are discussed below.

6.2.1.1 Old Landfill (Site 1) Erosion. The evaluation of remedial alternatives is presented in Section 5.2.1.2. Among the alternatives that involve removing a part of the Old Landfill, the staged removal by local labor is less expensive than outside contractor removal. Considering also the expected local acceptance of this alternative and the comparable protection/effectiveness of the two alternatives, the local-labor alternative is preferred. This conclusion could be reversed if the Alaskan Air Command's 5099 Civil Engineering Operation Squadron (CEOS) could be made available to implement the one-time removal.

Among the slope protective alternatives, the concrete block riprap is least expensive by a significant margin. Presuming similar effectiveness in protecting the bluff from erosion, and considering also the positive local labor impact and consequent local support for this alternative, the concrete-block riprap is preferred.

Finally, a numerical rating and ranking of the two preferred alternatives and the no action alternative, shown in Table 6-1, indicate that the two remedial actions are similarly desirable and slightly preferred over the no action alternative, if equal weights are used for all criteria included in the comparison. The choice between the two action alternatives then comes down to the two criteria considered most important, cost and effectiveness. Removal of landfill material is less costly, and removal will ensure effectiveness for some time (given the reasonable predictability of the bluff erosion rate). The retaining wall, on the other hand, is more costly and has some potential for failure and future maintenance, like any structure resisting ocean forces. Compared to these two aspects, the negative short-term impact of moving the landfill material is judged to be less important.

Consequently, removing of landfill material back from the bluff is the preferred IRM for the Old Landfill if remediation is desired. Considering the insignificant risk posed by the Old Landfill as assessed by the qualitative risk screening in Sections 4.4.2 and 4.4.3, the no action alternative is a viable, though less preferred option.

It is noted, finally, that both these alternatives have uncertain effectiveness over a very long-term period, say in excess of 30 years. Depending on actual bluff erosion rates, additional landfill material may need to be removed, and a retaining wall would likely need maintenance as well as extensions around the newly exposed sides of the wall.

Table 6-1. COMPARISON OF BAR-M OLD LANDFILL INITIAL REMEDIAL MEASURES

Proposed IRM	Cost	Effectiveness	Short-Term Impact	Implementability/ Feasibility	Acceptance	Sum
Remove Landfill Material	2	3	2	3	2	12
Concrete-Block Retaining Wall	1	2	3	3	2	11
No Action	3	0	3	3	1	10

Note: Rating 3 highest, most desirable
0 lowest, least desirable

6.2.1.2 New Landfill (Site 4) Leachate Generation. All action alternatives involve capping the inactive portion of the New Landfill to reduce leachate generation and distinguish capping using a native finer-grained material, available coarse-grained fill mixed with bentonite, or a synthetic membrane and available coarse-grained fill. The evaluation of remedial alternatives is presented in Section 5.2.2.

A numerical rating and ranking of four alternatives (the three action alternatives described above plus the no action alternative) is shown in Table 6-2. This table shows the highest ranking for the coarse native material plus bentonite based on equal weighting of the criteria used for comparison. However, the total scores are close, and therefore, as before, a more detailed comparison emphasizing effectiveness and cost was made.

The two highest-ranked alternatives, native granular material with bentonite (bentonite) and synthetic membrane with native granular material (membrane), are similarly protective, in that they are expected to effectively reduce infiltration into the landfill and have no local negative environmental impact except for use of a moderate (and approximately equal) quantity of gravel. However, the expected cost of the bentonite alternative is significantly lower. Compared to the bentonite alternative, the use of less pervious native material is expected to be similarly effective in reducing infiltration, but may have significant environmental impact on the tundra, where the tundra is to be mined to collect the finer-grained material. The expected cost of this alternative is only slightly less than the cost of the bentonite alternative. Finally, the no action alternative has minimal cost, but does not reduce infiltration. No action is a viable alternative because of the "insignificant" risk concluded by the qualitative risk screening. Future monitoring of the leachate outflow may be considered under the no action alternative.

Table 6-2. COMPARISON OF BAR-M NEW LANDFILL INITIAL REMEDIAL MEASURES TO MINIMIZE LEACHATE GENERATION

Proposed IRM	Cost	Protectiveness	Short-Term Impact	Implementability/ Feasibility	Acceptance	Sum
Less Pervious Native Material	2	2	2	2	2	10
Native Granular Material and Bentonite Admixture	1	3	3	3	3	14
Synthetic Membrane and Native Granular Material	0	3	3	3	3	13
No Action	3	0	3	3	2	11

Note: Rating 3 highest, most desirable
0 lowest, least desirable

In conclusion, if a remediation of the New Landfill leachate generation is desired, the preferred alternative is to cap the inactive portion of the landfill with locally available sand and gravel mixed with imported bentonite. This method will effectively reduce leachate generation, at a moderate cost, without damaging the tundra. The cost might be significantly reduced if the 5099 CEOS could be mobilized to do the work. Considering the "insignificant" risk posed by the New Landfill leachate, as identified in Section 4.4, the no action alternative is a viable, though less preferred, option.

6.2.1.3 Sewage Lagoon (Site 2) Leakage. The preferred IRM for the Sewage Lagoon leakage is to install an inverted filter around the pipe in the northwest corner of the gravel berm. Repair of the area adjacent to the pipe is recommended because the overall integrity of the berm may be compromised by the leakage.

6.2.2 Category 2 Sites

There are no Category 2 sites at BAR-M.

6.2.3 Category 3 Sites

There are no Category 3 sites at BAR-M.

6.3 BULLEN POINT AFS (POW-3)

6.3.1 Category 1 Sites

All sites at POW-3 are Category 1 sites. A POW-3 TDSNFA will be prepared and submitted as a separate document for these sites. The POW-3 Category 1 sites are Shed No. 1 (Site 1), Shed No. 2 (Site 2), Outside Transformer (Site 3), Inside Transformer (Site 4), POL Tanks (Site 5), and Old Landfill (Site 6).

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6.3.1.1 POL Tanks (Site 5). To remedy potential environmental problems, WCC recommends that, as an IRM, the remaining fuel be removed from the POL tanks to minimize the potential for future leakage and associated environmental contamination.

6.3.2 Category 2 Sites

There are no Category 2 sites at POW-3.

6.3.3 Category 3 Sites

There are no Category 3 sites at POW-3.

6.4 POINT LONELY AFS (POW-1)

6.4.1 Category 1 Sites

All sites at POW-1 except the Large Fuel Spill (Sites 29/29A) are Category 1 sites. A TDSNFA will be prepared and submitted as a separate document for the following sites: Old Sewage Outfall and Beach Tanks (Sites 25/27), POL Storage Area (Site 28), Old Landfill (Site 31), and Husky Landfill (Site 32).

To remedy a potential environmental problem, an IRM is recommended at the Husky Landfill, as discussed below. If bioremediation is successful in reducing TPHs concentrations in soil to below 5000 mg/kg, the POL Storage Area and Old Sewage Outfall and Beach Tanks will also be included in the bioremediation effort.

6.4.1.1 Husky Landfill (Site 32). To remedy potential environmental problems, WCC recommends, as an IRM, to minimize the water flow through the Husky Landfill. This will require independent remedial efforts for each of the three sources (i.e., Husky Camp gravel pad surface infiltration, infiltration from ponds east of the landfill, and percolation of rain and snowmelt). To control inflow from direct precipitation, sources creating

snowpack accumulation should be moved, and the permeable gravel cover over the fill should be capped with less permeable materials and graded to promote drainage away from the landfill. Flow from the east side ponds should be eliminated by creating a positive surface drainage channel to the south into an existing drainage system which flows southwest away from the pad into the tidal flats. Cutting off the infiltration from the main pad, which then flows through the landfill, should be done by construction of a cutoff wall on the east side of the landfill, consisting of a shallow grout curtain or soil-bentonite slurry wall. This wall would at the same time help to cut off the seepage from the ponds to the east.

As an innovative alternative to minimize inflow from the east, the permafrost surface could be drawn up into the landfill by addition of cover material over the landfill. If enough fill were added to raise the permafrost surface about 2 feet, the relatively impervious permafrost would change the subsurface hydraulic gradients enough to prevent the seepage from the east from entering the landfill mass.

6.4.2 Category 2 Sites

There are no Category 2 sites at POW-1.

6.4.3 Category 3 Sites

6.4.3.1 Large Fuel Spill (Sites 29/29A). The FS for the Large Fuel Spill Site evaluated several alternatives for remediation at the Fill and Tundra Operable Units at the Large Fuel Spill site. Figure 5-1 shows the locations of these operable units. The preferred alternatives for the Fill Operable Unit are 1A-No Action/Institutional Controls (Long-Term Monitoring), and 5A-Excavation/On-site Land Farming. The preferred alternatives for the Tundra Operable Unit are 1B-No Action/Institutional Controls and 3B-In situ Enhanced Biodegradation. An evaluation of the total cost and long-term effectiveness indicates Alternatives 5A and 3B as the recommended alternatives. Costs of alternatives are shown in Table 5-7. The permanent cleanup and estimated lower total costs made Alternatives 5A and 3B clearly preferable over Alternatives 1A and 1B.

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At the Fill Operable Unit, Alternative 5A calls for excavation and on-site landfarming of contaminated soils to volatilize and biodegrade the contaminants. At the Tundra Operable Unit, Alternative 3B uses in situ enhancement of biodegradation to achieve remediation. The bioremediation alternatives are recommended because of lower total costs and because of the permanent cleanup accomplished with minimal damage to the environment.

6.5 SUMMARY RECOMMENDATIONS

6.5.1 Barter Island AFS (BAR-M)

Old Landfill, Site 1 - Prepare TDSNFA. Recommend IRM to move a portion of the landfill material back from coastal and west side bluffs to minimize further loss of landfill material by erosion.

Sewage Lagoon, Site 2 - Prepare TDSNFA. Recommend IRM to place inverted filter at northwest corner pipe to minimize internal erosion.

POL Catchment and Area, Site 3 - Prepare TDSNFA.

New Landfill, Site 4 - Prepare TDSNFA. Recommend IRM to cap landfill with native sand/gravel mixed with bentonite to minimize infiltration and leachate generation.

Contaminated Ditch, Site 8 - Prepare TDSNFA.

Old Dump Site N.W., Site 9 - Prepare TDSNFA.

Old Airport Dump, Site 12 - Prepare TDSNFA.

6.5.2 Bullen Point AFS (POW-3)

Shed No. 1, Site 1 - Prepare TDSNFA.

Shed No. 2, Site 2 - Prepare TDSNFA.

Outside Transformer, Site 3 - Prepare TDSNFA.

Inside Transformer, Site 4 - Prepare TDSNFA.

POL Tanks, Site 5 - Prepare TDSNFA. Remove remaining fuel from tanks to minimize possible future leakage.

Old Landfill, Site 6 - Prepare TDSNFA.

6.5.3 Point Lonely AFS (POW-1)

Old Sewage Outfall and Beach Tanks, Sites 25/27 - Prepare TDSNFA.

POL Storage Area, Site 28 - Prepare TDSNFA.

Large Fuel Spill, Sites 29/29A - Prepare TDSRAA. Recommend remedial design and construction. Part of the Large Fuel Spill is a gravel pad area (Fill Operable Unit) of approximately 42,000 sq ft. It is recommended that this area be excavated and the soil be landfarmed. An adjacent tundra area (Tundra Operable Unit) of approximately 72,000 sq ft is also affected by the fuel spill. In situ enhanced biodegradation is recommended for this area.

Old Landfill, Site 31 - Prepare TDSNFA.

Husky Landfill, Site 32 - Prepare TDSNFA. Measures to minimize leachate may be implemented.

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TAB

Appendix A

APPENDIX A
GLOSSARY OF DEFINITIONS, NOMENCLATURE, AND UNITS OF MEASUREMENT

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APPENDIX A
GLOSSARY OF DEFINITIONS, NOMENCLATURE, AND UNITS OF MEASUREMENT

AAC	Alaskan Air Command
acetone	CH_3COCH_3 (propanone)
adsorption	The adhesion of molecules of gas, liquid, vapor, or dissolved matter onto the surface of a solid or liquid
AFS	Air Force Station
aliphatic hydrocarbons	Hydrocarbons (chemical compounds containing only hydrogen and carbon) in which the carbon atoms are linked in open chains rather than in rings
alluvium	Unconsolidated sediments deposited during comparatively recent geologic time by a stream or other body of running water
anadromous	Migrating up rivers from the sea to breed in fresh water
aqueous solubility	The amount of a substance that can be dissolved in water
aquifer	A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring

ARARs	Applicable or Relevant and Appropriate Requirements
Aroclor 1254	A mixture of polychlorinated biphenyls (PCBs)
aromatic	Designating cyclic organic compounds characterized by a high degree of stability in spite of their apparent unsaturated bonds and best exemplified by benzene and related structures, but also evident in other compounds
BAR-M	Barter Island AFS
beaded drainage	A pattern of small pools and short, minor streams connecting them, characteristic of an area underlain by permafrost
benzene	C_6H_6
bioassay	Strength evaluation of a drug, vitamin, hormone, or similar substance by comparing its effect on a test organism with that of a standard preparation on the test organism
BLM	United States Bureau of Land Management
bromomethane	CH_3Br (methyl bromide)
Cenozoic	The latest era of geologic time, extending from approximately 66 million years ago to the present, and including the Tertiary and Quaternary periods. Also refers to the corresponding system of rocks.

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CEOS	Civil Engineering Operation Squadron
cirque	A deep, steep-walled hollow or recess in a mountain, occurring at the upper end of a mountain valley
CLP	EPA Contract Laboratory Program
coliform	Colon bacillus, a bacterium found normally in all vertebrate intestines
Cretaceous	A period of geologic time in the Mesozoic Era, extending from approximately 144 to 66 million years ago. Also, the corresponding system of rocks.
cyclic	Pertaining to compounds having atoms arranged in a ring or closed-chain structure
cyclohexane	$\text{CH}_2(\text{CH}_2)_4\text{CH}_2$ (benzene hexahydride)
DEQPPM	Defense Environmental Quality Program Policy Memorandum
desorb	To remove an adsorbed substance from
Devonian	A period of geologic time (and corresponding system of rocks) in the Paleozoic Era, extending from approximately 408 to 360 million years ago.
DEW	Distant Early Warning

DFM	Cl_2CF_2 (dichlorodifluoromethane)
1,1-dibromochloromethane	CHClBr_2 (chlorodibromomethane)
1,1-dichloroethane	CH_3CHCl_2 (ethylidene chloride)
1,2-dichloroethane	$\text{ClCH}_2\text{CH}_2\text{Cl}$ (ethylene chloride)
trans-1,2-dichloroethene	CHClCHCl (dichloroethylene)
dichlorodifluoromethane	Cl_2CF_2 (difluorodichloromethane) (freon 12)
1,2-dichloropropane	$\text{CH}_3\text{CHClCH}_2\text{Cl}$ (propylene chloride)
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DRMO	Defense Reutilization and Marketing Office
drumlins	Steamlined hills or ridges of glacial drift; long axis parallels the flow direction of a former glacier.
ECD	Electron Capture Detector
effluent	A liquid waste discharge from a manufacturing or treatment process, in its natural state or partly or completely treated, that discharges into the environment
eolian deposits	Deposits arranged by the wind

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EPA	U.S. Environmental Protection Agency
equipotential surface	Having the same potential at every point on the surface
esker	A serpentine ridge of gravel and sand originating as deposits left in an ice-walled channel or tunnel in a melting ice sheet
ethyl benzene	$C_6H_5C_2H_5$
ethylene glycol	$HOCH_2CH_2OH$ (glycol) (1,2-ethanediol)
evapotranspiration	The return of precipitation to the air through direct evaporation and through the escape of water from plant tissue
firn	Snow above glaciers that has been partially consolidated by alternate freezing and thawing but not yet converted to glacial ice. The firn line is the level to which the snow recedes during seasonal glacial erosion.
fluorocarbon-113	CCl_3CF_3 (1,1,2-trifluoro-1,2,2-trichloroethane)
fluvial deposits	Sediments deposited by the action of flowing water
FS	Feasibility Study
GC	Gas Chromatograph

GC/MS	Gas chromatographic/mass spectrometric
glaciolacustrine	Pertaining to glacial lakes; formed in glacial lakes
gpm	Gallons per minute
halogen	Fluorine, chlorine, bromine, iodine, and astatine
halogenated	Combined with a halogen
HARM	Hazardous Assessment Rating Methodology
HDPE	High density polyethylene
HMA	Hot mix asphalt
honey buckets	55-gallon drums, containing untreated sewage waste
HQ TAC/DEEV	Headquarters Tactical Air Command, Environmental Planning Division
HSD	Halogen-specific detector
hydrologic	Pertaining to the physical properties and effects of water
ice field or icing	A large, level expanse of ice
ICP	Inductively coupled plasma atomic emission spectroscopy

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ICP	Inductively coupled plasma atomic emission spectroscopy
in situ	In place
IRM	Initial Remedial Measure
IRP	Installation Restoration Program
Jurassic	A period of geologic time (and corresponding system or rocks) in the Mesozoic Era, extending from approximately 208 to 144 million years ago.
kames	Short ridges or mounds of sand and gravel deposited during melting of or contact with glacial ice
Kow	Soil-water partition coefficient
LC50	Lethal Concentration 50, an experimentally derived estimate of the concentration of a chemical in water that will kill 50 percent of the exposed population of organisms in a defined period of time
LCS	Laboratory Control Samples
LD50	Lethal Dose 50, an experimentally derived estimate of the chemical dose that will kill 50 percent of the exposed population of organisms in a defined period of time. Dose is expressed in unit weight of chemical per unit weight of organism and is used when the chemical is administered orally, dermally, or parenterally (by injection).

leachate	The solution that results beyond or beneath a solid (such as soil or solid waste) after a liquid has percolated through it
lithologic	Pertaining to the physical characteristics of rocks
loess	A fine-grained silt with subordinate amounts of very fine sand and/or clay, thought to be a deposit of wind-blown dust
Log P	Logarithm of octanol-water partition coefficient
LUFT	Leaking underground fuel tank
Mesozoic	The third era of geologic time, following the Paleozoic and succeeded by the Cenozoic, extending from approximately 245 to 66 million years ago, and including the Triassic, Jurassic, and Cretaceous periods. Also refers to the corresponding system of rocks.
methylene chloride	CH_2Cl_2 (dichloromethane)
mg/m^3	milligrams per cubic meter
mg/kg	milligrams per kilogram (parts per million)
mg/L	milligrams per liter (parts per million)
$\mu\text{g}/\text{L}$	micrograms per liter (parts per billion)
mil	.001 inch (.0254 mm)

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moraines	An accumulation of boulders, stones, or other debris chiefly deposited by glaciers
MPN	Most probable number
m/yr	Meters per year
naphthenes	Any of several cycloparafin hydrocarbons having the general formula C_nH_{2n} , found in various petroleum
ND	Not detected
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
organochlorine pesticides	Hydrocarbon pesticides, such as DDT, that contain chlorine
organoleptic	Pertaining to or perceived by a sense organ
orographic	Pertaining to the physical geography of mountains and mountain ranges
PCBs	Polychlorinated biphenyls
periglacial	Pertaining to or deriving from conditions, processes, and formations that belong to the area bordering a glacier

permafrost	Any soil, subsoil, or other surficial deposit, or even bedrock, occurring in arctic or subarctic regions at a variable depth beneath the earth's surface in which a temperature below freezing has existed continuously for 2 years or more (in some cases, tens of thousands of years)
permeability	The property or capacity of a porous rock, sediment, or soil for transmitting a fluid without impairment of the structure of the medium; it is a measure of the relative ease of fluid flow under a pressure gradient.
PID	Photo-ionization detector
pingos	Relatively large mounds raised by frost action above the permafrost
Pleistocene	An epoch of geologic time in the Cenozoic era, extending from approximately 1.6 million to 10,000 years ago.
POL	Petroleum, oil, and lubricants
polygonal ground	Patterned ground marked by polygonal or polygon-like arrangements of rock, soil, and vegetation, produced by frost action
POTW	Publicly Operated Treatment Works
POW-1	Point Lonely AFS
POW-3	Bullen Point AFS

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ppb	Parts per billion
ppm	Parts per million
Precambrian	Geologic eras before the beginning of the Paleozoic, equivalent to about 90 percent of geologic time and ending approximately 570 million years ago
proglacial lake	A lake occupying a basin in front of a glacier generally in direct contact with the ice
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
Quaternary	The second and most recent period of geologic time in the Cenozoic era, extending from approximately 1.6 million years ago to the present, and including the Holocene and Pleistocene epochs. Also, the corresponding system of rocks.
RCRA	Resource Conservation and Recovery Act of 1976
RI/FS	Remedial Investigation/Feasibility Study
riprap	Natural stone or manmade concrete blocks
RMAL	Rocky Mountain Analytical Laboratory
SCS	Surrogate Control Sample
sheet flow	Flow at relatively low velocity, dispersed across an area rather than in a channel

SHPO	State Historical Preservation Officer (Alaska)
SOW	Statement of Work
stadia rod	A graduated rod used in surveying
talic	Unfrozen zone in permafrost
TDSNFA	Technical Document to Support No Further Action
TDSRAA	Technical Document to Support a Remedial Action Alternative
Tertiary	The first period of geologic time in the Cenozoic era, extending from approximately 66 to 1.6 million years ago, and including the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs. Also, the corresponding system of rocks.
tetrachloroethene	CCl_2CCl_2
TFM	CCl_3F (Trichlorofluoromethane)
thermokarst lakes	Lakes formed by the settling or caving in of ground due to the melting of ground ice
TOC	Total Organic Carbon
torr	A unit of pressure that equals .001316 atmosphere
toluene	$\text{CH}_3\text{C}_6\text{H}_5$ (methyl benzene)

TOX	Total Organic Halogens
TPHs	Total Petroleum Hydrocarbons
transpiration	The escape into the air of vapor containing waste products through skin pores or plant tissue stomata
Triassic	A period of geologic time in the Mesozoic Era, extending from approximately 245 to 208 million years ago. Also, the corresponding system of rocks.
1,1,1-trichloroethane	CH_3CCl_3 (methyl chloroform)
trichloroethene	$\text{ClCH}:\text{CCl}_2$ (trichloroethylene)
trichlorofluoromethane	CCl_3F (fluorotrichloromethane)
trichloromethane	CHCl_3 (chloroform)
USAF	United States Air Force
USAFOEHL/TS	United States Air Force Occupational and Environmental Health Laboratory, Technical Services Division
USC&GS	United States Coast and Geodetic Survey
viscous	Resistant to flow
vitrification	The changing of a substance into glass or into something glass-like, especially through heat fusion
WCC	Woodward-Clyde Consultants

TAB

Appendix B

APPENDIX B

STATEMENT OF WORK (SOW)

THE INSTALLATION RESTORATION PROGRAM (IRP)
REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

STAGE 3 FOR

DEW LINE STATIONS, ALASKA (TAC)

ORDER FOR SUPPLIES OR SERVICES										PAGE 1 OF 23		
2. PROC INSTRUMENT ID NO. (PIIN) F33615-85-D-4544		3. CALL/ORDER NO. 0008		4. DATE OF ORDER 88JUL06		5. REQUISITION/PURCHASE REQUEST PROJECT NO. FY7624-88-01624		6. CERTIFIED FOR NATIONAL DEFENSE UNDER DO-S1			DOC REG 2/DWS REG 1 RATING	
7. ISSUED BY DEPARTMENT OF THE AIR FORCE AIR FORCE SYSTEMS COMMAND AERONAUTICAL SYSTEMS DIV/PMRSC WRIGHT-PATTERSON AFB OH 45433-6503 CONTRACT NEGOTIATOR: JEFFREY H. MELLOTT PHONE: (513)-255-3042						8. ADMINISTERED BY DCASMA SAN FRANCISCO 1250 BAYHILL DR. SAN BRUNO CA 94066-3070						
9. CONTRACTOR NAME AND ADDRESS WOODWARD-CLYDE CONSULTANTS 500 12th STREET SUITE 500 OAKLAND, CA 94607-4014 PHONE: (415)-893-3600 COUNTY: ALAMEDA						FACILITY CODE IF "G" FOR MULTIPLE FACILITIES SEE SECT "G"		10. MAIL INVOICES TO				
11. DISCOUNT FOR PROMPT PAYMENT						12. PURCHASE OFFICE POINT OF CONTACT LTA/L67/LTA						
13. PAYMENT WILL BE MADE BY DCASR LOS ANGELES P.O. BOX 45011-0011 LOS ANGELES CA 90045-6197						14. TYPE CONTRACTOR A						
15. SECURITY A. CLAP U						16. CONTRACT ADMINISTRATION DATA A. PART PAY (1) KIND (2) TYPE O Y						
17. (RESERVED)						18. SVC AGENCY USE						
19. SURV CRIT						20. TOTAL AMOUNT NOT-TO-EXCEED 541,469.00						
21. APPROPRIATION AND ACCOUNTING DATA A. ACTY U B. ACRA AA C. APPROPRIATION 5783400 D. LIMIT SUBHEAD E. SUPPLEMENTAL ACCOUNTING CLASSIFICATION 308 7874 764495 070000 53201 000000 670700 F. CPM RECIPIENT DDRAAD F70700 G. OBLIGATION AMOUNT 541,469.00 H. NON-CLIN/ELIN PAYMENT PROV I. SVC AGENCY USE FY7624-88-01624						22. NON-DOD CONTRACT NO. This delivery order is subject to instructions contained on this side of form only and is issued in accordance with and subject to terms and conditions of above numbered contract, or Non-DOD Contract No.						
23. UNITED STATES OF AMERICA LARRY D. HAAS BY NAME OF CONTRACTING/ORDERING OFFICER AND DATE 88JUL15 TYNDDDD						24. TOTAL						
25. QUANTITY ORDERED HAS BEEN <input type="checkbox"/> INSPECTED <input type="checkbox"/> RECEIVED <input type="checkbox"/> ACCEPTED, AND CONFORMS TO THE CONTRACT EXCEPT AS STATED						26. SHIP NO.						
27. D.O. VOUCHER NO.						28. DIFFERENCES						
29. PAID BY						30. CHECK NUMBER						
31. BILL OF LADING NO.						32. RECEIVED AT						
33. RECEIVED BY						34. DATE RECEIVED						
35. TOTAL CONTAINERS						36. S/R ACCOUNT NUMBER						
37. S/R VOUCHER NO.						38. SIGNATURE AND TITLE OF CERTIFYING OFFICER						

PART I SECTION B OF THE SCHEDULE SUPPLIES LINE ITEM DATA			1. PROC INSTRUMENT ID NO. (PIIN) F33615-85-D-4544	2. SPIIN 0008	3. PAGE 2 OF 23
4. ITEM NO. 0001	5. QUANTITY 1	6. PURCH UNIT LO	7. UNIT PRICE \$N	8. TOTAL ITEM AMOUNT \$N	13. CIRB
9. SCTY NO. ACRN U AA N	11. NSN	12. FSCM AND PART NUMBER		16. SVC/AGENCY USE	
14. SITE CODES A. POA B. ACP C. POS D D D	15. NOUN	17. PR/MIPR DATA FY7624-88-01624			
18. AUTHORIZED RATE A. PROGRESS PAY B. RECoup		19. CONTRACT PERCENT FEE		20. SVC ID NO.	21. ITEM/PROJ MGR FY7624
22. 1ST DISCOUNT A. B. DAYS	23. 2ND DISCOUNT A. B. DAYS	24. 3RD DISCOUNT A. B. DAYS	25. NET DAYS	26. QUANTITY VARIANCE A. OVER B. UNDER	27. CONTRACT TYPE Y
29. DESCRIPTIVE DATA					

CONDUCT WORK IAW THE TASK DESCRIPTION OF THIS ORDER AND SECTION C, THE DESCRIPTION/SPECIFICATIONS OF THE BASIC CONTRACT. SUBMIT DATA IAW ATTACHMENT #1, THE CONTRACT DATA REQUIREMENTS LIST OF THE BASIC CONTRACT, AS IMPLEMENTED BY PARAGRAPH VI OF THE TASK DESCRIPTION.

4. ITEM NO.	5. QUANTITY	6. PURCH UNIT	7. UNIT PRICE	8. TOTAL ITEM AMOUNT	13. CIRB
0002	1	LO	\$N	\$N	
9. SCTY NO. ACRN U AA N	11. NSN	12. FSCM AND PART NUMBER		16. SVC/AGENCY USE	
14. SITE CODES A. POA B. ACP C. POS D D D	15. NOUN	17. PR/MIPR DATA FY7624-88-01624			
18. AUTHORIZED RATE A. PROGRESS PAY B. RECoup		19. CONTRACT PERCENT FEE		20. SVC ID NO.	21. ITEM/PROJ MGR FY7624
22. 1ST DISCOUNT A. B. DAYS	23. 2ND DISCOUNT A. B. DAYS	24. 3RD DISCOUNT A. B. DAYS	25. NET DAYS	26. QUANTITY VARIANCE A. OVER B. UNDER	27. CONTRACT TYPE Y
29. DESCRIPTIVE DATA					

PROVIDE SUPPORT IN ACCORDANCE WITH THE TASK DESCRIPTION OF THIS ORDER AND SECTION C, THE DESCRIPTION/SPECIFICATIONS OF THE BASIC CONTRACT.

*REPRESENTS NET AMOUNT OF INCREASE/DECREASE WHEN MODIFYING EXISTING ITEM NO

N = NOT APPLICABLE
U = UNDEFINIZED
NSP = NOT SEPARATELY PRICED

E = ESTIMATED
- (IN QTY AND \$) = DECREASE
+ OR - (IN ITEM NO) = ADDITION OR DELETION
CIRB CONTROLLED ITEM RPT EQMT

SITE
CODES

S = SOURCE
B = DESTINATION
O = INTERMEDIATE

PART I SECTION B OF THE SCHEDULE SUPPLIES LINE ITEM DATA			1. PROC INSTRUMENT ID NO. (PIIN) F33615-85-D-4544		2. SPIIN 0008	3. PAGE 3 OF 23
4. ITEM NO. 0003	5. QUANTITY 1	6. PURCH UNIT LO	7. UNIT PRICE \$ N	8. TOTAL ITEM AMOUNT \$ N		13. CIRR
9. SCTY/ISO ACRA U AA N		12. FSCM AND PART NUMBER		15. SVC/AGENCY USE		
14. SITE CODES A PDA B.ACP C.FOB		15. NOUN D D D COMPUTER SOFTWARE		16. SVC/AGENCY USE		
17. PR/MIPR DATA FY7624-88-01624		18. AUTHORIZED RATE A. PROGRESS PAY B. RECOUP		19. CONTRACT PERCENT FEE		20. SVC ID NO.
22. 1ST DISCOUNT A. B.DAYS		23. 2ND DISCOUNT A. B.DAYS		24. 3RD DISCOUNT A. B.DAYS		25. NET DAYS
26. QUANTITY VARIANCE A. OVER		27. CONTRACT TYPE FY7624		28. OPR Y		
29. DESCRIPTIVE DATA						

SUBMIT COMPUTER SOFTWARE AND DOCUMENTATION IAW ATTACHMENT #2, THE CONTRACT DATA REQUIREMENTS LIST OF THE BASIC CONTRACT, AS IMPLEMENTED BY PARAGRAPH VI OF THE TASK DESCRIPTION.

4. ITEM NO. 0004			5. QUANTITY 1	6. PURCH UNIT LO	7. UNIT PRICE \$ N	8. TOTAL ITEM AMOUNT \$ N	13. CIRR
9. SCTY/ISO ACRA U AA N		12. FSCM AND PART NUMBER		15. SVC/AGENCY USE			
14. SITE CODES A PDA B.ACP C.FOB		15. NOUN D D D CHEM ANALYSIS AND DATA		16. SVC/AGENCY USE			
17. PR/MIPR DATA FY7624-88-01624		18. AUTHORIZED RATE A. PROGRESS PAY B. RECOUP		19. CONTRACT PERCENT FEE		20. SVC ID NO.	21. ITEM/PROJ MGR
22. 1ST DISCOUNT A. B.DAYS		23. 2ND DISCOUNT A. B.DAYS		24. 3RD DISCOUNT A. B.DAYS		25. NET DAYS	26. QUANTITY VARIANCE A. OVER
27. CONTRACT TYPE FY7624		28. OPR J					
29. DESCRIPTIVE DATA							

PERFORM CHEMICAL TESTS IAW THE TASK DESCRIPTION OF THIS ORDER AND SECTION C, THE DESCRIPTION/SPECIFICATIONS OF THE BASIC CONTRACT. SUBMIT DATA IAW ATTACHMENT #1, THE CONTRACT DATA REQUIREMENTS LIST OF THE BASIC CONTRACT, AS IMPLEMENTED BY PARAGRAPH VI OF THE TASK DESCRIPTION.

88 Jun 16

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STATEMENT OF WORK (SOW)**THE INSTALLATION RESTORATION PROGRAM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)****STAGE 3 FOR****DEW LINE STATIONS, ALASKA (TAC)****I. DESCRIPTION OF WORK**

1.1 Scope. The objective of the Air Force Installation Restoration Program (IRP) is to assess past hazardous waste disposal and spill sites on Air Force installations and develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which pose a threat to human health and welfare or the environment. The intent is to conduct the remedial investigation and feasibility study in parallel instead of in serial fashion. The USAFOEHL/TS Handbook, Version 2.0, dated April 1988 (mailed under separate cover), and the DEW Line Sites, AK, Stage 3 Work Plan and Quality Assurance Project Plan (QAPP) are an integral part of this task. All references in this Statement of Work to the "Handbook" refer to the above version of the USAFOEHL/TS Handbook and imply by reference that it is provided under separate cover. The contractor shall comply with all Handbook, Work Plan and QAPP requirements. Section 1 of the Handbook lists all documents that apply to this Statement of Work (SOW). The contractor shall accomplish the following actions for this stage of the IRP process at the DEW Lines:

- a. literature search,
- b. determine public health and environmental requirements,
- c. field investigation,
- d. baseline risk assessment,
- e. develop preliminary alternative remedial actions,
- f. initial screening of alternatives,
- g. detailed analysis of alternatives,
- h. develop Data Quality Objectives (DQOs) for any follow-on effort,
- i. prepare Reports, Plans and Decision Documents.

1.2 Literature Search. Conduct a literature search to determine the geological, hydrogeological, and environmental settings for this investigation. Requirements are supplied under separate cover (see "Environmental Setting", Section II of the Report Format, contained in Section 3, USAFOEHL/TS Handbook). When gathering information for the demographic setting and conducting the well inventory, consider only those populations and wells within a three mile radius of the installation. Sources include: IRP Phase I Report, IRP Stage 1 Report, IRP Stage 2 Report,

Federal and State geological agency reports, academic theses and related university research, municipality and county reports, and historical and current aerial photographs. Cite all bibliographic references reviewed, including personal communications, in the appropriate part of the report. Identify gaps in data or analyses which may prevent an adequate determination of contaminant migration patterns or other factors critical to assessing the hazard potential associated with the individual sites.

1.3 Public Health and Environmental Requirements. Review the DQOs developed during the previous IRP Stage and reevaluate the threat of contaminants to public health and welfare or the environment through a literature search of documents. This effort shall satisfy the requirements contained in the Superfund Amendments and Reauthorization Act (SARA) of 1986, to identify all Applicable or Relevant and Appropriate Requirements (ARARs). Sources for ARARs are listed in the Handbook, Section 2.

1.4. Field Investigation. As used in this SOW, 'field investigation' refers to the collection of all data, environmental and biological samples, and subsequent laboratory analysis of samples. The purpose of data collection, sample collection and laboratory analysis is to determine whether any contaminants generated from installation activities are entering the environment. The field investigation is used to determine the source and extent of any identified contaminants, and the magnitude of contamination relative to ARARs and any naturally occurring or background concentrations for specific compounds.

1.4.1 Quality Assurance/Quality Control (QA/QC). A quality assurance/quality control (QA/QC) program shall be conducted and documented for ALL work specified in this Delivery Order. The USAFOEHL approved QA/QC program is described in the IRP Stage 3 Quality Assurance Project Plan (QAPP).

1.4.1.1 Data generated under the QA/QC program shall be used to evaluate the analytical results assembled for each site and to formulate conclusions and recommendations pertaining to the need for additional site investigations or remediation.

1.4.1.2 QA/QC requirements for chemical analyses, laboratory operations, required detection limits, field operations, sampling, sample preservation, sample holding times, equipment contamination, and chain-of-custody are delineated in the Handbook, Section 12. Project specific QA/QC requirements, if applicable, are described in paragraph 1.4.13, Site-specific Requirements.

1.4.1.3 Annex A, Tables A-4 and A-5 specify the maximum number of field QA/QC samples allowed for each analytical parameter for the entire investigative effort. The distribution of field QA/QC samples by site, sampling round, etc., is specified in the IRP Stage 3 Work Plan.

1.4.2 Regulatory Requirements and Permits. All activities pertaining to this effort must conform to State and other applicable regulatory agency requirements. Cite references in an appendix to the Final Report (paragraph I.1.11.1). Complete permits, applications, and other documents which may be required by local and/or State regulatory agencies for

certain field activities. File these documents with appropriate agencies and pay all applicable permitting and filing fees.

1.4.3 Shallow Soil Augerings. Conduct a maximum of two (2) shallow soil augerings using a hand or power auger (see Annex A, Table A-1 for distribution by site). Total footage for all shallow soil augerings shall not exceed twelve (12) feet. Collect one soil sample from each augering (maximum of two (2) auger samples). Permanently mark each location. Record the location on a project map for each specific site or zone, whichever is applicable.

1.4.4 Surveying. Determine the locations of all sampling points with respect to existing land features using hand-held instruments. Record the positions on both project and site-specific maps.

1.4.5 Augering Precautions. Mark the field locations of both shallow soil augerings during the planning/mobilization phase of the field investigation. Consult with base personnel to minimize disruption of base activities, to properly position augerings with respect to site locations, and to avoid underground utilities.

1.4.6 Borehole Cleanup. Dispose of all borehole cuttings per direction of the base civil engineer and clean the general area following the completion of each borehole. The cuttings may be spread over the general area in the vicinity of the borehole or transported to more suitable areas for disposal.

1.4.7 Containerized Materials. The contractor shall label any drums containing hazardous waste, prepare and sign the manifest documents as an agent for the Air Force. Labelling and packaging of the hazardous waste shall be in accordance with DOT regulations. The contractor is also responsible for transporting all labelled drums from the site to the Defense Reutilization and Marketing Office (DRMO) located at Elmendorf AFB AK. HQ TAC/DEEV is responsible for interim storage and ultimate disposal of all drums.

1.4.8 Sample Collection.

1.4.8.1 Water Samples. Collect a maximum of thirty-three (33) surface water and liquid samples. The maximum number of analyses for each parameter and the required analytical method is given in Table A-4, Annex A.

1.4.8.2 Soil and Sediment Samples. Collect a maximum of forty-seven (47) soil and sediment samples. The maximum number of analyses for each parameter and the required analytical method is given in Table A-5, Annex A.

1.4.9 Site-specific Requirements. Perform the site-specific requirements as listed in the following sub-paragraphs. The field tasks shall be performed as specified in Section 5 of the IRP Stage 3 Work Plan. Refer to Annex A of this SOW, Table A-1 for the number of shallow hand augerings by site. Table A-2 lists water analyses by site, and Table A-3 lists soil analyses by site.

1.4.9.1 Site 1 (BAR-M). Old Landfill (Old Dump).

a. Field tasks include: Five (5) surface water samples, four (4) sediment samples, and an engineering study for erosion control.

1.4.9.2 Site 2 (BAR-M). Sewage Lagoon.

a. Field tasks include: Three (3) surface water samples, one (1) sediment sample, and a determination of the hydrologic budget of the lagoon.

1.4.9.3 Site 3 (BAR-M). POL Catchment Area (Waste Petroleum Disposal).

a. Field tasks include: Four (4) surface water samples and seven (7) sediment/soil samples.

1.4.9.4 Site 4 (BAR-M). New Landfill (Current Dump).

a. Field tasks include: Four (4) surface water samples and four (4) sediment samples.

1.4.9.5 Site 8 (BAR-M). Contaminated Ditch (Drainage Cut).

a. Field tasks include: Three (3) surface water samples and three (3) sediment samples.

1.4.9.6 Site 25/27 (POW-1). Old Sewage Outfall Location and Beach Tanks.

a. Field tasks include: Three (3) sediment samples.

1.4.9.7 Site 28 (POW-1). POL Storage Area.

a. Field tasks include: One (1) surface water sample and seven (7) soil samples.

1.4.9.8 Site 29/29a (POW-1). Large Fuel Spill Area.

a. Field tasks include: Two hand-augered boreholes, three (3) surface water samples, one (1) sediment sample, and six (6) soil samples.

1.4.9.9 Site 31 (POW-1). Old Landfill.

a. Field tasks include: Two (2) surface water samples and two (2) sediment samples.

1.4.9.10 Site 32 (POW-1). Husky Landfill.

a. Field tasks include: Five (5) surface water samples, three (3) sediment samples, and two (2) soil samples.

1.4.9.11 Site 1 (POW-3). Shed Number 1.

a. Field tasks include: Removal and shipment of containers.

1.4.9.12 Site 2 (POW-3). Shed Number 2.

a. Field tasks include: Field test for halogens, one (1) sample of liquid from the floor, and removal and shipment of material.

1.4.9.13 Site 3 (POW-3). Outside Transformer.

a. Field tasks include: Field test for PCBs, removal and shipment of material.

1.4.9.14 Site 4 (POW-3). Inside Transformer.

a. Field tasks include: Field test for PCBs, removal and shipment of transformer and up to one (1) 55-gallon drum of soil, and two (2) confirmatory soil samples for PCBs.

1.4.9.15 Site 5 (POW-3). POL Tanks.

a. Field tasks include: Visual inspection of tank integrity and estimation of volume of fluid in tanks and piping.

1.4.9.16 Site 6 (POW-3). Old Landfill Site.

a. Field tasks include: Two (2) surface water samples and four (4) sediment/soil samples.

1.5 Baseline Risk Assessment. After a thorough review of all data gathered during the field investigation and the establishment of ARARs (paragraph I.1.3), determine the potential risk to human health and welfare or the environment from the contaminants identified at the various sites investigated. The required elements of the baseline risk assessment are provided in the Handbook, Section 3 (Report Format Section IV). Include results of the baseline risk assessment in Section IV of the Final Report (paragraph I.1.11.1). Identify those sites posing no threat to human health, welfare or the environment and which no further action is appropriate. Prepare a decision document to support this finding (paragraph I.1.10.1).

1.6 Preliminary Alternative Remedial Actions (FS Phase I). For all past hazardous waste disposal and spill sites investigated at the DEW Line stations except those where no further action is applicable, utilize the data and conclusions obtained from the hydrogeological survey, site characterization, and baseline risk assessment to develop preliminary alternative remedial actions. If preliminary remedial actions were developed during a previous IRP Stage, reevaluate the remedial actions selected based on the newly collected data. The required elements for the FS Phase I are provided in the Handbook, Section 3 (Report Format Section V). Alternatives developed shall include the following categories:

- a. Alternatives for off-site treatment and/or disposal
- b. Alternatives that attain ARARs
- c. Alternatives that exceed ARARs

- d. Alternatives that do not attain ARARs
- e. No action

Further, alternatives outside of these categories may also be developed, such as non-cleanup alternatives (e.g., alternate water supply, relocation, etc). Documentation of the remedial alternative development process, including the decision rationale, shall be provided as an Informal Technical Information Report (Item VI, Sequence No. 3, paragraph 6.1) and shall be included in Section V of the Final Report (paragraph I.1.11.1).

1.7 Initial Screening of Alternatives (FS Phase II). The alternatives developed in paragraph I.1.6 shall be screened to eliminate those that are clearly infeasible or inappropriate, prior to undertaking detailed evaluation of the remaining alternatives. The required elements for the FS Phase II are provided in the Handbook, Section 3 (Report Format Section V). An Informal Technical Information Report shall be prepared detailing the screening process and identifying the alternatives remaining (Item VI, Sequence No. 3, Paragraph 6.1). This decision process shall be included in Section V of the Final Report (paragraph I.1.11.1).

1.8 Detailed Analysis of Alternatives (FS Phase III). Perform a detailed analysis of the alternatives remaining after the initial screening. The required elements for the FS Phase II are provided in the Handbook, Section 3 (Report Format Section V). Additional guidance can be found in EPA/540/G-85/003, Guidance on Feasibility Studies Under CERCLA. Provide an Informal Technical Information Report describing the analysis procedures, results and conclusions to the USAFOEHL/TS (Item VI, Sequence No. 3, paragraph 6.1). The detailed analysis will include the following:

- a. Technical Analysis
- b. Environmental Analysis
- c. Public Health Analysis
- d. Institutional Analysis
- e. Cost Analysis
- f. Evaluation of Alternatives

The analysis procedures, decision process, results and conclusions of the detailed analysis shall be included in Section V of the Final Report (paragraph I.1.11.1). Score all sites where a remedial alternative is selected using the Defense Site Remediation Priority Model (DSRPM). Guidance is provided in the Handbook, Section 9, and in the DSRPM Users Manual (provided under separate cover).

1.9 Data Quality Objectives (DQOs). For those sites where contamination is detected but the available data does not permit completing the detailed analysis of alternatives, identify and define the DQOs necessary to complete the feasibility study and risk assessment. These

DQOs will define the scope of the Work Plan to be prepared for any follow-on IRP task order (I.1.12.2.1). Incorporate the DQOs into Section VI of the Final Report (paragraph I.1.11.1).

1.10 Decision Documents.

1.10.1 Technical Document to Support No Further Action. Using the format provided in the Handbook, Section 11, prepare a decision document for each IRP site where the results of this investigation indicate that no significant threat to human health and welfare or the environment exists (Item VI, Sequence No. 4, paragraph 6.1).

1.11 Reports

1.11.1 Final Report. Prepare a report delineating all findings from this investigative stage of the remedial investigation/feasibility study. Review the Results, Conclusions and Recommendations concerning the sites listed in this task which were investigated during a previous IRP stage work effort. Use this information and data from previous efforts to establish trends and develop conclusions and recommendations. Integrate all investigative work done at each site to date so that the report reflects the total cumulative information for each site studied in this effort. Environmental sample results shall be analyzed with respect to QA/QC data unique to this project. Summary statistics shall be used and reported when justified by the amount and quality of data. This report must also include a detailed discussion of the recommended alternative remedial actions and a description of any work proposed, including the DQOs for any follow-on remedial investigation and feasibility study that may be required. Forward the report to USAFOEHL/TS for Air Force and regulatory agency review (Item VI, Sequence No. 4, paragraph 6.1).

1.11.1.1 Draft Reports. Draft reports are considered "drafts" only in the sense that they have not been reviewed and approved by the Air Force. In all other respects, "drafts" must be complete, in the proper format, and free of grammatical and typographical errors. All draft reports shall be thoroughly screened through in-house peer technical review before being released to USAFOEHL/TS.

1.11.1.2 Report Format. Strictly adhere to the USAFOEHL/TS Report Format (USAFOEHL/TS Handbook, Section 3) for preparation of draft and Final Reports. This format is an integral part of this Delivery Order.

1.11.1.3 Microfiche Copies of Final Report. Provide three (3) microfiche copies of the approved Final Report (Item VI, Sequence No. 17, paragraph 6.1).

1.11.1.4 Digitized Installation Map. Construct three (3) installation maps, one each for BAR-M, POW-1, and POW-3, which locate all sites and sampling locations on a single sheet. When available, use existing digitized map files. Construct and digitize these maps as specified in the Handbook, Section 3, Attachment 1. Provide a Mylar copy of each map (Item VI, Sequence No. 3, paragraph 6.1) to USAFOEHL/TS with the first Draft Report. Provide the digitized data on USAF compatible computer media with the Mylar copies (Item VI, Atch 2, Sequence No. 1, paragraph 6.2).

1.11.2 **Analytical Data.** Upon completion of all analyses, tabulate and incorporate all analytical data into an Informal Technical Information Report and forward the report to USAFOEHL/TS no later than three (3) weeks after all analyses have been completed (Item VI, Sequence No. 3, paragraph 6.1). Use the format provided in the USAFOEHL/TS Handbook, Section 8.

1.12 Plans.

1.12.1 Plans for Current Effort.

1.12.1.1 **Health and Safety Plan.** Provide a written Health and Safety Plan within six (6) after the Notice To Proceed (NTP) (Item VI, Sequence No. 3, paragraph 6.1). Comply with USAF, OSHA, EPA, State and local health and safety regulations regarding the upcoming work effort. Use EPA guidelines for designating the appropriate levels of protection needed at the study sites. Coordinate the Health and Safety Plan directly with applicable regulatory agencies prior to submittal to USAFOEHL/TS. Provide the USAFOEHL/TS TPM with evidence of Health and Safety Plan approval prior to the start of field work.

1.12.2 **Plans for Follow-up Effort.** For those sites where no further action is not appropriate and the available data does not permit detailed analysis of alternatives, the contractor shall initiate preparation of plans for any follow-up effort only after all Air Force comments to the first draft Report (paragraph 1.1.11.1) are received.

1.12.2.1 **Work Plan For Next Effort.** Use the Work Plan format provided in the Handbook, Section 4. Forward all copies to USAFOEHL/TS (Item VI, Sequence No. 4, paragraph 6.1).

1.12.2.2 **Cost Proposal.** In a separate letter, submit a lump sum cost estimate for the effort required to perform the work detailed in the Work Plan for the next effort (Item VI, Sequence No. 2, paragraph 6.1).

1.13 **Data Management.** In addition to the hard copy of the field and laboratory test results submitted with the monthly R & D Status Report, data collected in this effort shall be archived with Air Force-compatible computer hardware and software and forwarded to USAFOEHL/TS per format and media instruction provided in the Handbook, Section 7. (Item VI, Atch 2, Sequence No. 1, paragraph 6.2). Additional detailed guidance is provided in the Installation Restoration Program Information Management System (IRPIMS) Data Loading Handbook (provided under separate cover).

1.14 **Meetings.** A maximum of three (3) contractor personnel shall attend two (2) meetings at Elmendorf AFB AK. Each meeting shall be two 8-hour workdays in duration. All meetings shall be coordinated by USAFOEHL/TS.

1.15 **Special Notifications.** Immediately report to the USAFOEHL/TS TPM or his/her supervisor, via telephone, any data/results generated during this investigation which may indicate an imminent health risk. Follow the telephone notification with a written notice within three (3) days and

attach a copy of the raw laboratory data (e.g., chromatograms, standards used for calibration, etc).

1.16 R & D Status Reports. Include all data as required by the USAFOEHL/TS Handbook, Section 6. Tabulated field and laboratory test results and QA/QC data shall be incorporated into the next monthly R & D Status Report as they become available and forwarded to the USAFOEHL/TS (Item VI, Sequence No. 1, paragraph 6.1).

1.17 The above technical efforts which include maximum requirements are estimates only. Should the contractor determine technical efforts, including field work, require variation from these estimates, the contractor shall obtain a written concurrence from the contracting officer's technical representative at USAFOEHL/TS. This concurrence is required prior to proceeding with the variation. Under such circumstances the ceiling price of this order shall remain unchanged. Should an increase in the ceiling amount be necessary contracting officer authorization will be required prior to proceeding with the variation.

II. SITE LOCATIONS AND DATES:

Barter Island AFS AK
Bullen Point AFS AK
Point Lonely AFS AK
Date to be established

III. BASE SUPPORT

The Base POC will:

3.1 Be responsible for locating underground utilities and issuing digging or other appropriate permits to the IRP contractor prior to the commencement of digging or drilling operations.

3.2 Provide the contractor with existing engineering plans, drawings, diagrams, aerial photographs, digitized map files, etc., to facilitate evaluation of IRP sites under investigation.

3.3 Arrange for, and have available prior to the start-up of field work, the following services, materials, work space, and items of equipment to support the contractor during the investigation:

a. Personnel identification badges, vehicle passes and/or entry permits.

b. A secure staging area (approximately 100 square feet) for storing equipment and supplies.

c. A supply of potable water (up to 165 gallons) for equipment cleaning, etc.

d. A temporary office area, not to exceed 100 square feet and equipped with a Class A telephone for local and long distance telephone calls. The contractor shall pay for any long distance telephone calls made by contractor personnel from this phone. This office area may be simply a desk and chair in the sleeping areas at the sites.

e. No on-site base support will be required at POW-3, with the exception of the water specified in paragraph 3.3c above.

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f. A set of keys to the locks on any of the facilities where an investigation is planned. The keys shall be returned to the Base POC by the contractor when the survey has been completed.

g. Lodging and meals on a cost reimbursable basis at BAR-M and POW-1.

h. Supply the contractor with the appropriate Generator Number to be used in preparing and signing of the manifest documents as an agent for the U.S. Air Force.

i. Coordinate with the contractor and DRMO the transportation and acceptance of the hazardous waste at the DRMO facility at Elmendorf AFB, Ak.

IV. GOVERNMENT FURNISHED PROPERTY: None.

V. GOVERNMENT POINTS OF CONTACT:

5.1 USAFOEHL/TS
Technical Program Manager (TPM)
1Lt Franz J. Schmidt
USAFOEHL/TSS
Brooks AFB TX 78235-5501
(512) 536-9001 ext. 227
AV 240-9001 ext. 227
1-800-821-4528 ext. 227

5.2 Base Point of Contact (POC)
HQ TAC/DEEV
Mr Joseph K. FitzGerald
Langley AFB VA 23665-5542
(804) 764-7844
(AV) 574-4430

VI. DELIVERABLES

6.1 Attachment 1 of the basic contract. In addition to Sequence Numbers 1 and 5 listed in Attachment 1 to the basic contract which apply to all orders, the Sequence Numbers and dates listed below are applicable to this order:

<u>Sequence No.</u>	<u>Para No.</u>	<u>Block 10</u>	<u>Block 11</u>	<u>Block 12</u>	<u>Block 13</u>	<u>Block 14</u>
3 (Health & Safety)	I.1.12.1.1	OTIME	88JUN24	88JUL08	-	10
3 (ITIR-Analytical Data)	I.1.11.2	OTIME	*	*	-	4
3 (ITIR-Prelim. RA)	I.1.6	OTIME	88SEP05	88SEP05	-	4
3 (ITIR-Screen of RAs)	I.1.7	OTIME	88SEP05	88SEP12	-	4
3 (ITIR-Detail. Anal. of RAs)	I.1.8	OTIME	88SEP05	88SEP26	-	4
3 (ITIR-Mylar Maps)	I.1.11.1.4	OTIME	88SEP05	88SEP26	-	2
4 (Decision Documents)	I.1.10	ONE/R	88SEP05	88OCT10	89FEB06	***
4 (Tech. Rpt)	I.1.11.1	ONE/R	88AUG01	88OCT10	89FEB06	**
4 (Work Plan)	I.1.12.2.1	ONE/R	88NOV28	89JAN02	89MAR06	****
2 (Cost Letter)	I.1.12.2.2	OTIME	89JAN02	89FEB06	-	3
17 (Microfiche)	I.1.11.1.3	OTIME	89FEB06	89FEB13	-	3

6.2 Attachment 2 of the basic contract.

<u>Sequence No.</u>	<u>Para No.</u>	<u>Block 10</u>	<u>Block 11</u>	<u>Block 12</u>	<u>Block 13</u>	<u>Block 14</u>
1 (Data Management)	I.1.13	OTIME	*	*	-	1
1 (Digitized Data)	I.1.11.1.4	OTIME	88SEP05	88OCT10	-	1

6.3 Notes:.

* For the analytical data, provide the ITIR upon completion of the total analytical effort and not later than three weeks after all analyses have been completed.

** One first draft report (15 copies), one second draft report (25 copies), and one Final Report (50 copies plus the original camera-ready copy) are required. Incorporate Air Force comments into the second draft and Final Reports as specified by USAFOEHL/TS. Supply USAFOEHL/TS with an advance copy of the first draft, second draft, and Final Reports for acceptance prior to distribution. Distribute the remaining 14 copies of the first draft report, 24 copies of the second draft report, and 49 copies of the Final Report as specified by USAFOEHL/TS.

*** One draft (15 copies) and one final (10 copies) of each decision document is required. Supply the USAFOEHL/TS with one advance copy of each draft and final decision document for acceptance prior to distribution. Incorporate Air Force comments into the final decision documents as specified by USAFOEHL/TS. Distribute the remaining 14 copies of the draft and 9 copies of the final decision documents as specified by USAFOEHL/TS.

**** One first draft Plan (15 copies), one second draft Plan (20 copies), and one Final Plan (25 copies) are required. Incorporate Air Force comments into the second draft and Final Plan as specified by USAFOEHL/TS. Supply USAFOEHL/TS with an advance copy of the first draft, second draft, and Final Plan for acceptance prior to distribution. Distribute the remaining 14 copies of the first draft Plan, 19 copies of the second draft plan, and 24 copies of the Final Plan as specified by USAFOEHL/TS.

ANNEX A Table A-1
Summary of Field Work by Site

	POW-1 Site 29/29a	POW-3 Site 1	POW-3 Site 2	POW-3 Site 3	POW-3 Site 4	Total
No. of Augerings	2	--	--	--	--	2
Material Removal and Shipment	no	yes	yes	yes	yes	--

ANNEX A, Table A-2
Approximate Number of Water Analyses by Site

PARAMETER	ANALYTICAL METHOD	BAR-M Site 1	BAR-M Site 2	BAR-M Site 3	BAR-M Site 4	BAR-M Site 8	POW-1 Site 28	POW-1 Site 29/ 29a	POW-1 Site 31	POW-1 Site 32	POW-3 Site 2	POW-3 Site 3	POW-3 Site 4	POW-3 Site 6	Total
Specific Conductance (Field Test)	E120.1	5	3	4	4	3	1	3	2	5	1	0	0	2	33
pH (Field Test)	E150.1	5	3	4	4	3	1	3	2	5	1	0	0	2	33
Temperature (Field Test)	E170.1	5	3	4	4	3	1	3	2	5	1	0	0	2	33
Petroleum Hydrocarbons	E418.1	5	3	4	4	3	1	3	2	5	1	0	0	2	33
Total Coliforms	SM9132	2	2	0	0	3	0	0	0	0	0	0	0	0	7
ICP Screen (23 metals, exclude Boron and Silica)	SM3005/ SM6010														
Total Recoverable Dissolved		5	3	0	4	3	0	0	2	5	0	0	0	2	24
		5	3	0	4	3	0	0	2	5	0	0	0	2	24
Purgeable Halocarbons	SM5030/ SM8010	0	0	0	4	3	0	0	2	5	1	0	0	2	17
Purgeable Aromatics	SM5030/ SM8020	0	0	0	4	3	0	0	2	5	1	0	0	2	17
PCBs	SM3510/ SM8080	5	3	0	4	3	0	0	2	5	1	1	1	2	27
PCB Field Test	McGraw-Edison Field Test	0	0	0	0	0	0	0	0	0	0	1	4	0	5
Halogens field Test	Chlor/D/Test	0	0	0	0	0	0	0	0	0	1	0	0	0	1

ANNEX A, Table A-3
Approximate Number of Soil Analyses by Site

PARAMETER	ANALYTICAL METHOD	BAR-M Site 1	BAR-M Site 2	BAR-M Site 3	BAR-M Site 4	BAR-M Site 8	POW-1 Site 25/ 27	POW-1 Site 28	POW-1 Site 29/ 29a	POW-1 Site 31	POW-1 Site 32	POW-3 Site 4	POW-3 Site 6	Total
Petroleum Hydrocarbons	SW3550/ E418.1	4	1	7	4	3	3	7	7	2	5	0	4	47
ICP Screen (23 metals, exclude Boron and Silicon)	SW3050/ SW6010	4	1	0	4	3	0	0	0	2	5	0	4	23
PCBs	SW3550/ SW8080	4	1	0	4	3	3	0	0	2	5	2	4	28
Volatile Organic Compounds	SW8240	4	1	0	4	3	1	0	0	2	5	0	4	24
Soil Moisture Content	ASTM D2216	4	1	7	4	3	3	7	7	2	5	0	4	47

ANNEX A, Table A-4
Analytical Methods and TOTAL Number of Water Analyses

PARAMETER	ANALYTICAL METHOD (a)	REPORTING UNITS	NUMBER OF ANALYSES	TRIP BLANKS	AMB COND BLANKS	DUP/REP	SECOND COLUMN (f)	TOTAL ANALYSES
Specific Conductance	E140.1	umhos	32	0	0	4	0	37
pH (Field Test)	E150.1	pH Units	32	0	0	4	0	37
Temperature (Field Test)	E170.1	deg C	32	0	0	4	0	37
Petroleum Hydrocarbons	E418.1	mg/L	32	0	0	4	0	37
Total Coliforms	SW9132	CFU/100 mL	7	0	0	1	0	8
ICP Screen (23 metals exclude Boron and Silica)	SW3005/ SW6010	mg/L						
Total Recoverable Dissolved (c)			24	0	0	3	0	27
			24	0	0	3	0	27
Purgeable Halocarbons	SW5030/ SW8010	ug/L	17	3	3	2	13	38
Purgeable Aromatics	SW5030/ SW8020	ug/L	17	3	3	2	13	38
PCBs	SW3510/ SW8080	ug/L	27	0	0	3	16	46
PCBs Field Test	McGraw-Edison Field Test	mg/L	5	0	0	1	0	6
Halogens Field Test	Chlor/D/Test	mg/L	1	0	0	1	0	2

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030-3000 4044/0000

ANNEX A, Table A-5
Analytical Methods and TOTAL Number of Soil Analyses (b)

PARAMETER	ANALYTICAL METHOD (a)	REPORTING UNITS	NUMBER OF ANALYSES	TRIP BLANKS	AMB COND BLANKS	DUP/REP	SECOND COLUMN (f)	TOTAL ANALYSES
Petroleum Hydrocarbons	SW3550/ E418.1	mg/kg	47	0	0	5	0	52
ICP Screen (23 metals, exclude Boron and Silica)	SW3050/ SW6010	mg/kg	23	0	0	3	0	26
PCBs	SW3550/ SW8080	mg/kg	28	0	0	3	16	47
Volatile Organic Compounds	SW8240	mg/kg	24	3	3	3	0	33
Soil Moisture Content (b)	ASTM D2216	per cent (%)	47	0	0	5	0	52

NOTES

- a Unless an abbreviated list of analytes is specified under "Parameter" above, the analytical protocol shall include all analytes listed in the referenced analytical method. The methods cited are from the following sources:

"A" Methods	Standard Methods for the Examination of Water and Wastewater, 16th Edition (1985)
"E" Methods	Methods for Chemical Analysis of Water and Wastes, EPA Manual, 600/4-79-020 (USEPA, 1983 - with additions)
"SW" Methods	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition (USEPA, 1986)
"ASTM" Methods	American Society for Testing and Materials, 1919 Race Street, Philadelphia PA 19103

- b. For soil/sediment samples, report results as mg/kg of dry soil or sediment. Report moisture content for each sample. Contractor shall modify the equation for calculation of moisture content in ASTM D-2216 to read:

$$w = [(W1-W2)/(W1-WC)] \times 100$$

where w = moisture content, %

$W1$ = weight of container and moist soil, g

$W2$ = weight of container and oven-dried soil, g

WC = weight of container, g.

- c The sample shall be filtered in the field through a 0.5 μ m filter at the time of sample collection and before sample preservation.
- d Modified for soils. See Method A412, p. 329, Standard Methods for the Examination of Water and Wastewater, 16th Edition (1985).
- e Analyze for all 52 toxic characteristic contaminants listed in the Federal Register.

- f The maximum number of second-column confirmational analyses shall not exceed fifty percent (50%) of the actual number of field samples (to include duplicates, replicates, ambient condition blanks, trip blanks and equipment blanks). If the number of samples requiring second-column confirmation exceeds this allowance, contact the USAF/OEHL/TS Technical Program Manager. The total number of samples listed in Tables A-4 and A-5 includes the allowance applicable to each GC method. If GC/MS, or a combination of second-column GC and GC/MS, is used, the total cost of all such analyses for a particular parameter shall not exceed the funding allowed for positive confirmation using only second-column GC.

PART I SECTION F OF THE SCHEDULE
SUPPLIES SCHEDULE DATA

1. PROC INSTRUMENT ID NO. (PIIN)

2. SPIIN

3.

F33615-85-D-4544

0008

PAGE 22 OF 23

4. ITEM NO.	5. ACRN	6. TSP PRI	7. MILSTRIP DOC NO. AND SUFFIX	8. COM ITEM SERIAL NO.	9. ENDING SERIAL NO. (WHEN APPL)	10. CLIN IDENT EXHIBIT
0001	AA					
11. DEL SCHED DATE	12. ENDING DATE (WHEN APPL)	13. DEL SCHEDULE QTY*	14. SCTY CLAS	15. SHIP TO	16. MARK FOR	
A. 89DEC29	A.	A. 1	U	FY7624		
B.	B.	B.	D.	D.	D.	
C.	C.	C.	E.	E.	E.	
17. DESCRIPTIVE DATA						

SEE SECTION H OF THE BASIC CONTRACT FOR FY7624 ADDRESS.
TECHNICAL EFFORT SHALL BE COMPLETED NO LATER THAN 89 FEB 06.

ALL DATA SHALL BE DELIVERED IAW ATTACHMENT #1 OF THE BASIC
CONTRACT AS IMPLEMENTED BY PARAGRAPH VI OF THE TASK DESCRIPTION
NO LATER THAN 89 MAR 06.
THE DATA SHALL BE ACCEPTED BY THE GOVERNMENT NOT LATER THAN THE DATE
SHOWN IN BLOCK 11A.

4. ITEM NO.	5. ACRN	6. TSP PRI	7. MILSTRIP DOC NO. AND SUFFIX	8. COM ITEM SERIAL NO.	9. ENDING SERIAL NO. (WHEN APPL)	10. CLIN IDENT EXHIBIT
0002	AA					
11. DEL SCHED DATE	12. ENDING DATE (WHEN APPL)	13. DEL SCHEDULE QTY*	14. SCTY CLAS	15. SHIP TO	16. MARK FOR	
A. 89DEC29	A.	A. 1	U	FY7624		
B.	B.	B.	D.	D.	D.	
C.	C.	C.	E.	E.	E.	
17. DESCRIPTIVE DATA						

SEE SECTION H OF THE BASIC CONTRACT FOR FY7624 ADDRESS.
TECHNICAL EFFORT SHALL BE COMPLETED NO LATER THAN 89 FEB 06.

4. ITEM NO.	5. ACRN	6. TSP PRI	7. MILSTRIP DOC NO. AND SUFFIX	8. COM ITEM SERIAL NO.	9. ENDING SERIAL NO. (WHEN APPL)	10. CLIN IDENT EXHIBIT
0003	AA					
11. DEL SCHED DATE	12. ENDING DATE (WHEN APPL)	13. DEL SCHEDULE QTY*	14. SCTY CLAS	15. SHIP TO	16. MARK FOR	
A. 89DEC29	A.	A. 1	U	FY7624		
B.	B.	B.	D.	D.	D.	
C.	C.	C.	E.	E.	E.	
17. DESCRIPTIVE DATA						

SEE SECTION H OF THE BASIC CONTRACT FOR FY7624 ADDRESS.
TECHNICAL EFFORT SHALL BE COMPLETED NO LATER THAN 89 FEB 06.

ALL COMPUTER SOFTWARE/DATA SHALL BE DELIVERED IAW ATTACHMENT #2
AS IMPLEMENTED BY PARAGRAPH VI OF THE TASK DESCRIPTION
NO LATER THAN 89 MAR 06.
THE DATA SHALL BE ACCEPTED BY THE GOVERNMENT NOT LATER THAN THE DATE
SHOWN IN BLOCK 11A.

* REPRESENTS A NET INCREASE/DECREASE WHEN NO + OR - APPEARS AFTER THE ITEM NO

E = ESTIMATED

- (IN QTY) = DECREASE

+ OR - (IN ITEM NO) = ADDITION OR DELETION

PART I SECTION F OF THE SCHEDULE SUPPLIES SCHEDULE DATA				1. PROC INSTRUMENT ID NO. (PIIN) F33615-85-D-4544	2. SPIIN 0008	3. PAGE 23 OF 23
4. ITEM NO. 0004	5. ACRN AA	6. TSP PRI	7. MILSTRIP DOC NO. AND SUFFIX	8. CON ITEM SERIAL NO.	9. ENDING SERIAL NO. (WHEN APPL)	10. CLIN IDENT EXHIBIT
11. DEL SCHED DATE A. 89DEC29	12. ENDING DATE (WHEN APPL) A.	13. DEL SCHEDULE QTY* A. 1	14. SCTY U	15. SHIP TO FY7624	16. MARK FOR	
B.	B.	B.	D.	D.	D.	
C.	C.	C.	E.	E.	E.	
17. DESCRIPTIVE DATA						
SEE SECTION H OF THE BASIC CONTRACT FOR FY7624 ADDRESS. TECHNICAL EFFORT SHALL BE COMPLETED NO LATER THAN 89 FEB 06.						
ALL CHEMICAL ANALYSIS DATA SHALL BE DELIVERED IAW ATTACHMENT #1 AS IMPLEMENTED BY PARAGRAPH VI OF THE TASK DESCRIPTION. NO LATER THAN 89 MAR 06.						
THE DATA SHALL BE ACCEPTED BY THE GOVERNMENT NOT LATER THAN THE DATE SHOWN IN BLOCK 11A.						
4. ITEM NO.	5. ACRN	6. TSP PRI	7. MILSTRIP DOC NO. AND SUFFIX	8. CON ITEM SERIAL NO.	9. ENDING SERIAL NO. (WHEN APPL)	10. CLIN IDENT EXHIBIT
11. DEL SCHED DATE A.	12. ENDING DATE (WHEN APPL) A.	13. DEL SCHEDULE QTY* A.	14. SCTY CLAS	15. SHIP TO	16. MARK FOR	
B.	B.	B.	D.	D.	D.	
C.	C.	C.	E.	E.	E.	
17. DESCRIPTIVE DATA						
THIS ORDER FURTHER INCORPORATES BY REFERENCE ASD/PMRSC LETTER AUTHORIZATION DATED 88JUL07 AND DESIGNATED ORDER NO 0008. ANY COSTS INCURRED OR PAYMENTS MADE UNDER THE PROVISIONS OF THE INSTRUMENT REFERENCED WILL BE CONSIDERED TO HAVE BEEN MADE UNDER THIS INSTRUMENT.						
4. ITEM NO.	5. ACRN	6. TSP PRI	7. MILSTRIP DOC NO. AND SUFFIX	8. CON ITEM SERIAL NO.	9. ENDING SERIAL NO. (WHEN APPL)	10. CLIN IDENT EXHIBIT
11. DEL SCHED DATE A.	12. ENDING DATE (WHEN APPL) A.	13. DEL SCHEDULE QTY* A.	14. SCTY CLAS	15. SHIP TO	16. MARK FOR	
B.	B.	B.	D.	D.	C.	
C.	C.	C.	E.	E.	E.	
17. DESCRIPTIVE DATA						

* REPRESENTS A NET INCREASE/DECREASE WHEN NO + OR - APPEARS AFTER THE ITEM NO
E = ESTIMATED

- (IN QTY) = DECREASE

+ OR - (IN ITEM NO.) = ADDITION OR DELETION

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT					1. PAGE 1 OF 4	
2. PROC INSTRUMENT ID NO. (PIIN) F33615-85-D-4544		3. SPIIN 000801	4. EFFECTIVE DATE 88SEP15	5. REQUISITION/PURCHASE REQUEST PROJECT NO. FY7624-88-01650		6. BDC/DMS RATING
7. ISSUED BY DEPARTMENT OF THE AIR FORCE AIR FORCE SYSTEMS COMMAND AERONAUTICAL SYSTEMS DIV/PMRSC WRIGHT-PATTERSON AFB, OH 45433-6503 NEGOTIATOR: JEFFREY H. MELLOTT PHONE: (513) 255-5911			8. ADMINISTERED BY (IF OTHER THAN BLOCK 7) CODE S0507A DCASMA SAN FRANCISCO 1250 BAYHILL DRIVE SAN BRUNO, CA 94066-3070			
9. CONTRACTOR NAME AND ADDRESS WOODWARD-CLYDE CONSULTANTS 500 12TH STREET, SUITE 100 OAKLAND, CA 94607-4014 COUNTY: ALAMEDA PHONE: (415) 945-3000			10. SECURITY CLASS U		11. DISCOUNT FOR PROMPT PAYMENT 1. NET DAYS 2. OTHER IF 3. SEE SECT "E"	
12. PURCHASE OFFICE POINT OF CONTACT LTA/LO5/LTA			13. THIS BLOCK APPLIES ONLY TO AMENDMENTS OF SOLICITATIONS <input type="checkbox"/> The above numbered solicitation is amended as set forth in block 17. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation, or as amended by one of the following methods: (a) By signing and returning _____ copies of this amendment. (b) By acknowledging receipt of this amendment on each copy of the offer submitted or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE ISSUING OFFICE PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER if by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter provided such telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.			
14. THIS BLOCK APPLIES ONLY TO MODIFICATIONS OF CONTRACTS <input type="checkbox"/> THIS CHANGE IS ISSUED PURSUANT TO _____ THE CHANGES SET FORTH HEREIN ARE MADE TO THE ABOVE NUMBERED CONTRACT/ORDER. <input type="checkbox"/> THE ABOVE NUMBERED CONTRACT IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (SUCH AS CHANGES IN PAYING OFFICE, APPROPRIATION DATA, ETC.) SET FORTH HEREIN. <input type="checkbox"/> THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF _____ IT MODIFIES THE ABOVE NUMBERED CONTRACT AS SET FORTH HEREIN. <input checked="" type="checkbox"/> THIS MODIFICATION IS ISSUED PURSUANT TO THE "ORDERING" CLAUSE OF THE CONTRACT CLAUSES						
15. CONTRACT ADMINISTRATION DATA A. KIND OF MOD. B. MOD ASST. C. DATE OF SIGNATURE D. CHANGE IN CONTRACT AMOUNT E. LOSING PD/CAO F. GAINING PD/CAO G. SVC/AGENCY OF MOD. RECIPIENT ADD PT. MODIFICATION (TYPE) (+) DECREASE (-) ON TRANSFER ON TRANSFER USE B 12,000.00+ (NIE)						
16. ENTER ANY APPLICABLE CHANGES A. PAY CODE B. EFFECTIVE DATE C. CONTRACT D. TYPE E. BURY F. SPL CONTR G. PAYING OFC H. DATE SIGNED I. SECURITY OF AWARD (1) TYPE (2) KIND CONTR CRIT PROVISIONS CODE (1) CLAS (2) DATE OF DD 254						
17. REMARKS (Except as provided herein, all items and conditions of the contract, as heretofore changed, remain unchanged and in full force and effect) SUBJECT: REV OF TASK DESCRIPTION: WORK /FUNDS W/IN SCOPE OF BASIC ORDER PROJECT MONITOR: EMILE BALADI, USAFOEHL/TS, BROOKS AFB, TX 78235-5501 FINANCE OFFICE: (S0506A) DCASR LOS ANGELES, P.O. BOX 45011-0011 LOS ANGELES, CA 90045-6197						
18. CONTRACTOR/OFFEROR IS NOT REQUIRED TO SIGN THIS DOCUMENT <input checked="" type="checkbox"/> CONTRACTOR/OFFEROR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN COPIES TO ISSUING OFFICE <input type="checkbox"/>						
19. CONTRACTOR/OFFEROR (Signature of person authorized to sign)			22. UNITED STATES OF AMERICA (Signature of Contracting Officer)			
20. NAME AND TITLE OF SIGNER (Type or print)			21. DATE SIGNED		23. NAME OF CONTRACTING OFFICER (Type or print)	
					24. DATE SIGNED	
					88SEP16	

SCHEDULE OF CHANGES

- FIRST: Block 20 of page 1 (55X) of the basic order is hereby revised to reflect the increase of the not-to-exceed amount of the subject order to \$553,469.00, an increase of \$12,000.00.
- SECOND: The task description of the basic order is revised as set forth on page 3 herein.
- THIRD: Section G, Accounting Classification Data (69K) is amended as set forth on page 4 herein.
- FOURTH: The contractor's letter, dated 88 Sep 13, evidencing concurrence with this action is incorporated herein by reference and made a part hereof.
- FIFTH: This modification constitutes full settlement of any claims of the contractor under the contract, including the clause entitled "Changes - Time and Materials or Labor Hours," arising out of or by reason of the changes effected hereby.

TASK DESCRIPTION
(Revision #1)

THE INSTALLATION RESTORATION PROGRAM
REMEDIAL INVESTIGATION/FEASIBILITY STUDY(RI/FS)
STAGE 3 FOR
DEW LINE STATIONS, ALASKA (TAC)

88 Sep 07

ParagraphChange

I.1.4.9.14

REPLACE PARAGRAPH WITH THE FOLLOWING:

Site 4 (POW-3). Inside Transformer Building.

a. Field tasks include: Field test for PCBs, removal and shipment of transformer and up to one (1) 55-gallon drum of soil, two (2) confirmatory soil samples for PCBs, and removal of up to eight (8) drums of waste oil and hazardous materials from the site.

PART I SECTION C OF THE SCHEDULE ACCOUNTING CLASSIFICATION DATA			1. PRIC INSTRUMENT ID NO. (PIIN) F33615-85-D-4544	2. SPIIN 000801	3. PAGE 4 OF 4
4. APPROPRIATION AND ACCOUNTING DATA A. ACTY CLAS B. ACRN C. APPROPRIATION U AA 5783400			5. SUPPLEMENTAL ACCTS CLASSIFICATION 308 7874 764495 070000 53201 000000 67071		
6. CPM RECIPIENT 000AAB F70700			7. OBLIGATION AMOUNT* \$12,000.00+		
8. NON-CLIN/ELIN			9. PR/MIPR DATA FY7624-88-01650+		
10. PAYING OFC CODE			(PR COMPLETE)		
11. DESCRIPTIVE DATA AF FORM 616, HS88-207, CHANGE 3, DATED 88 SEP 07.					
4. APPROPRIATION AND ACCOUNTING DATA A. ACTY CLAS B. ACRN C. APPROPRIATION			5. SUPPLEMENTAL ACCTS CLASSIFICATION		
6. CPM RECIPIENT 000AAB			7. OBLIGATION AMOUNT*		
8. NON-CLIN/ELIN			9. PR/MIPR DATA		
10. PAYING OFC CODE					
11. DESCRIPTIVE DATA					
4. APPROPRIATION AND ACCOUNTING DATA A. ACTY CLAS B. ACRN C. APPROPRIATION			5. SUPPLEMENTAL ACCTS CLASSIFICATION		
6. CPM RECIPIENT 000AAB			7. OBLIGATION AMOUNT*		
8. NON-CLIN/ELIN			9. PR/MIPR DATA		
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11. DESCRIPTIVE DATA					
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6. CPM RECIPIENT 000AAB			7. OBLIGATION AMOUNT*		
8. NON-CLIN/ELIN			9. PR/MIPR DATA		
10. PAYING OFC CODE					
11. DESCRIPTIVE DATA					

* REPRESENTS NET AMOUNT OF INCREASE DECREASE WHEN MODIFYING AN EXISTING ACRN.

+ OR - IN ACRN = ADDITION OR DELETION - IN \$ - DECREASE

NOTE TO CONTRACTOR: Submit invoices to paying office unless otherwise specified in the descriptive data item here

TAB

Appendix C

APPENDIX C
RAW FIELD DATA

46 294

K. Mobley
Field Notes
DEWLINE
Aug 1988



TRANSIT

NOTEBOOK NO. 301

MOBILE

900000

Aug 1988

Chow Times AOT
 Breakfast 730-815
 Lunch 1300 1330
 Dinner 1830 1915

3

-
 =
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 十九
 二十
 二十一
 二十二
 二十三
 二十四
 二十五
 二十六
 二十七
 二十八
 二十九
 三十

Lin. Aer. Dev. 640-3902
 Martin Air 659-2544
 Cape Smythe Air 640-6820 Mark Sims
 654-2270 12:15 +
 Pt Lundy 791-3001

Willow 303 440 0543
 Tree 303 442 5783

Aug 16 200 Arrive Airport - Fly to Poullos

1900 Air

1025 Arrive Poullos / Meet Air picked up

1200 Left Poullos Arrived 1250

1310 Talked with Paul Moore - Station

Superintendent

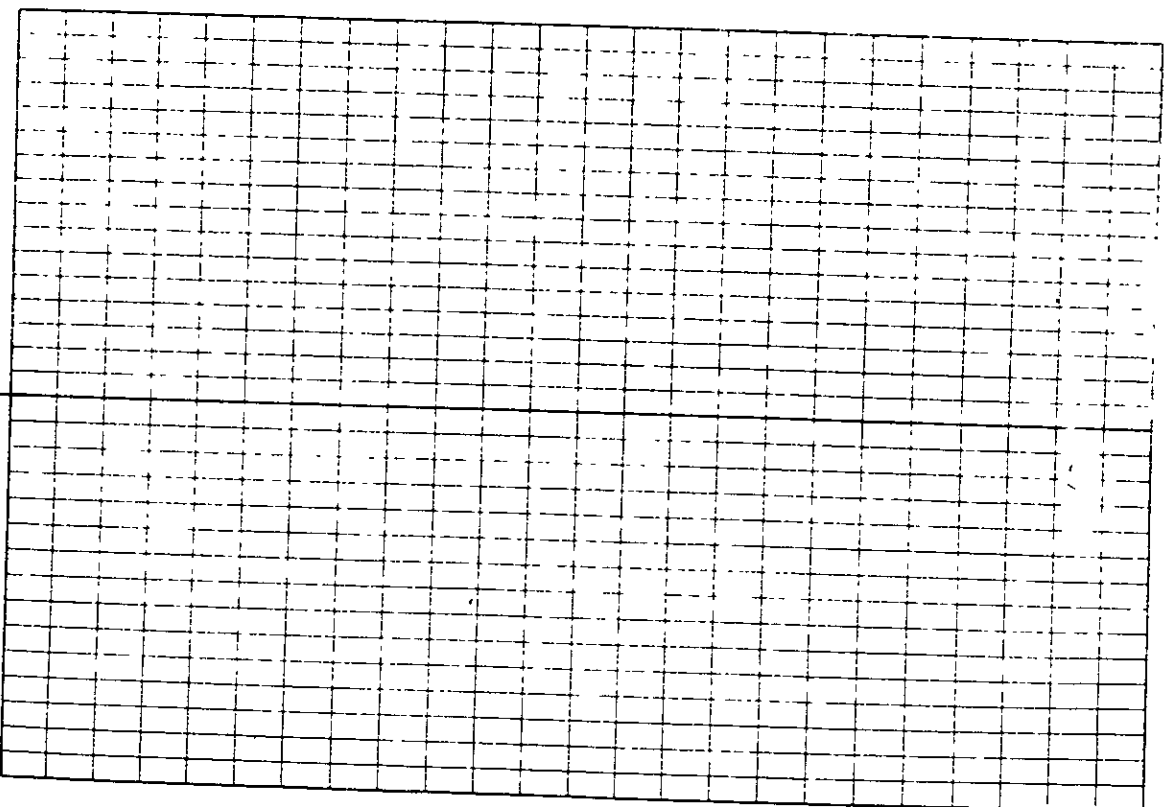
Met Air misinformed about quantity
of cargo. Should get in by tomorrow

1430 Met with Paul Moore to explain our
purpose here. He was very helpful
and explained rules and places where
we can (and cannot go). It will not
affect our work

1630 Another load of goods arrived @
our camp - Went with Paul to
receive

1725 The 4 of us walked over the entire
site. First impression Site was nearly
as bad as preliminary report

田島 水



Aug 16 (cont)

S. ft. Spang. M. for

1) Pot confinement. Good soils previously small deficit in center has some confinement.

2) Senozi. logan. Only notable feature no outlet.

3) Old landfill. Erosion problems many included be a significant problem. Doesn't look too bad yet. Problem will continue

4) New landfill. Seepage out bottom may be trouble some to correct. Mostly looking seepage on down gradient side

5) Contaminated Ditch. Contaminant not very significant. Seepage will fall

sting.

Final review 1835

8/16/85

Aug 17 Spent AM sorting bottles, labels and such
to get ready to Sample

Still don't have everything here, but
can start!

AK airlines flies only 5 days / wk so
can't sample Friday or Saturday and make
hold times

1200 Started digging and locating sample sites

Spent all afternoon reviewing plan, SW
WHS to figure out sample locations

Note: It is obvious to me that
wherever put them together 1) Did I
know what was going on and 2) Had
never been to the site or is extremely
permeable about hazardous wastes.

There are problems at Baker Island
but they are not serious, they are
not 1/5 threatening

墨嘉冰

Aug 18 Sampled Soil Samples All day

Worked as a single team in order to make sure of all the details, sample locations and procedures.

All of us question the decan sequence but ~~Butler~~ followed it strictly

In PM Robin returned to office to start packing samples.

After dinner all 4 of us spent 1 1/2 hours packing samples.

See Jim Munter's notebook for notes of samples, site description etc for all sites taking soil samples.

12/17/70 JK

BLANK

12/17/70 JK

Aug 19: Started Mapping Site

Survey line!

Measure 90' pt. 11.1 to N edge of 3 tanks
to middle of road

Measured 185' to intersection of dump
roads, from tank

Measured 19.8' along road

Sunday June 2

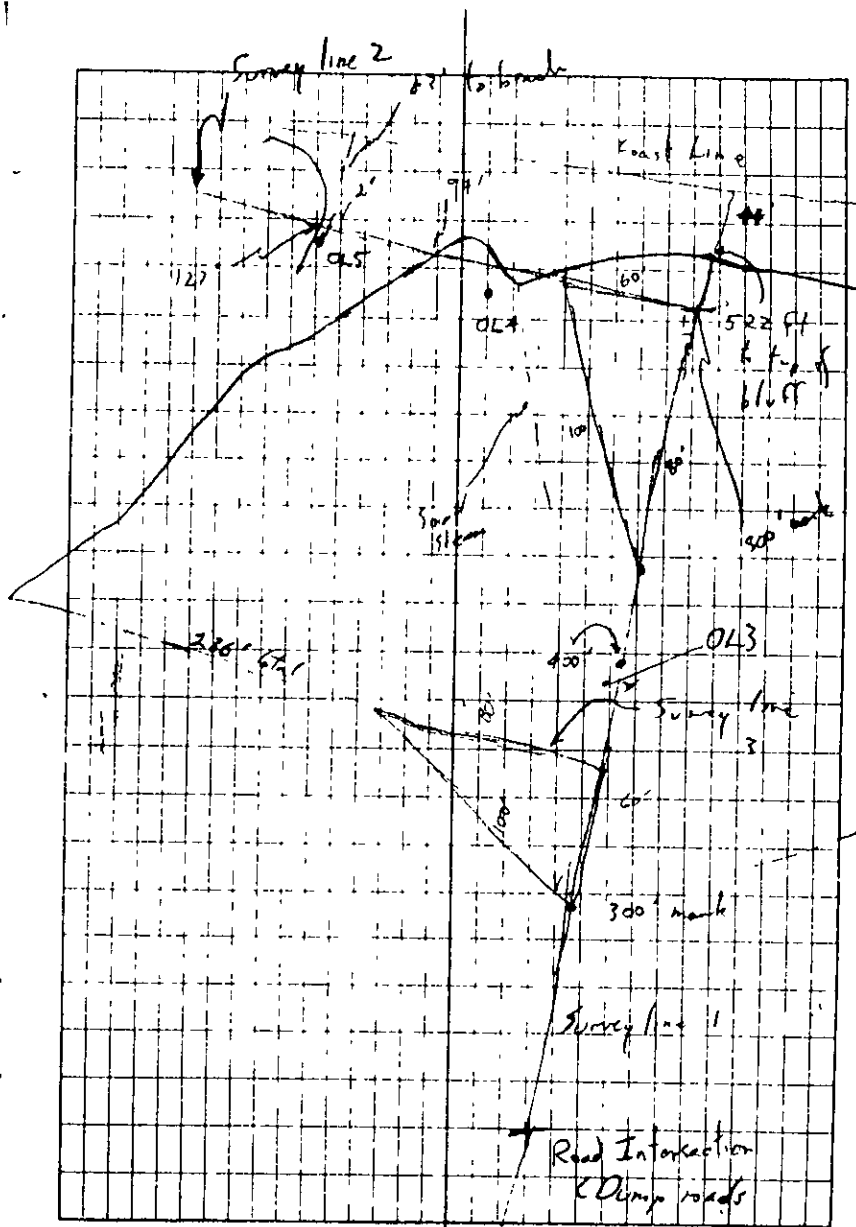
Measured 3, 4, 5 Triangle to west of
Survey line 1, 90° angle @ 500' from
road intersection

Survey Line 3 Measured 3.45. Triangle, 90° &

from line 1 @ 360' from intersection.

West west 236' from line 1 to top of
Drainage

243 is 5' south and 2' west of
400' mark of Survey line 1



Survey line 3

OL1 is 6' south of 262' mark on Survey line 3

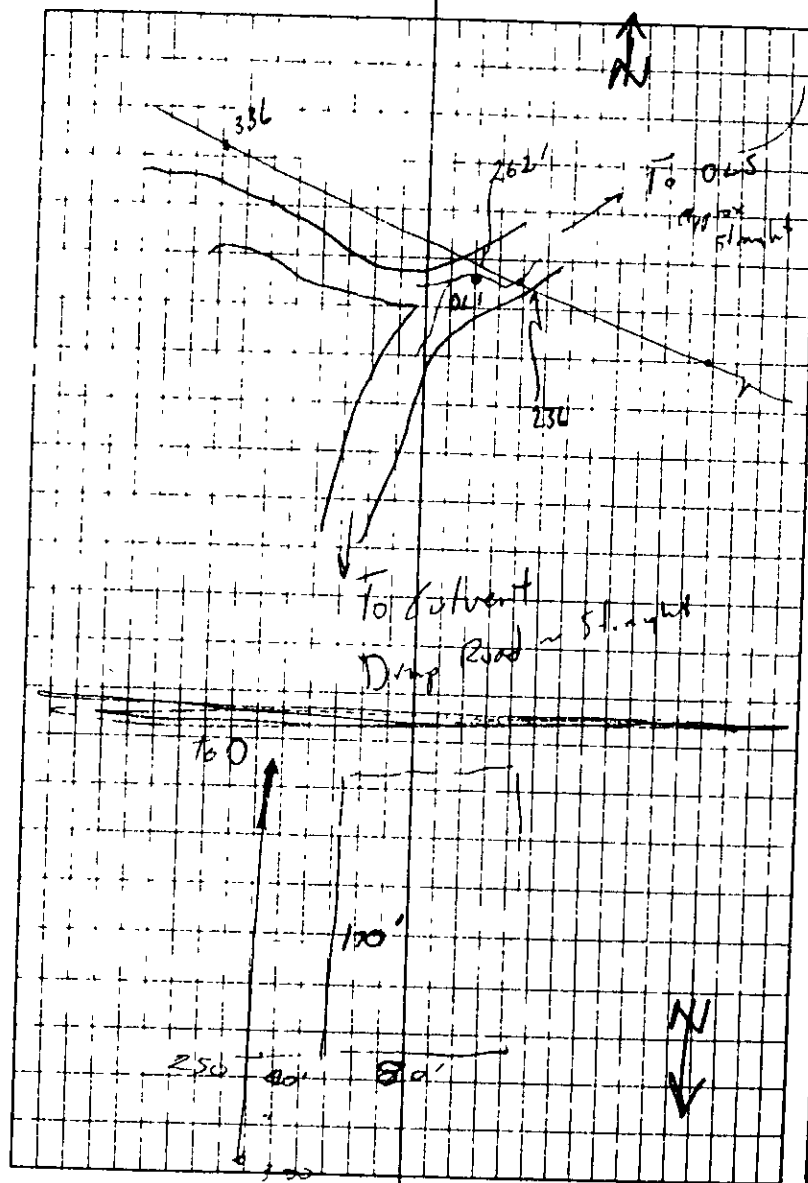
SW stream bank, southward @ 336
(water ~10' south of line 3)

Measure from 242 mark Survey line 3
G 245 196.5'

Honey Beech Ind

Paced off, See map
opposite page

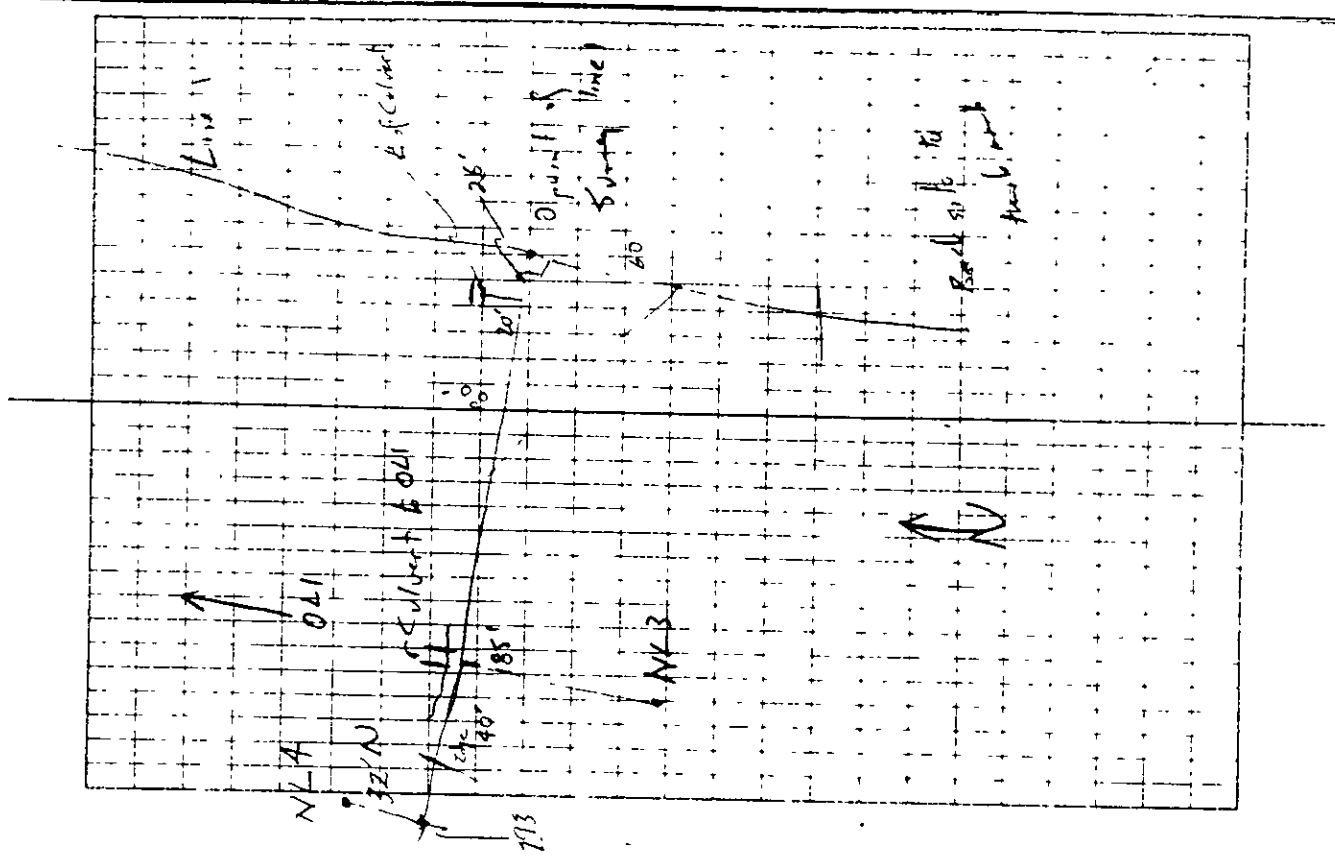
黑点 水



Survey line 1

黑点 水

Survey line 4
 on O point of Survey line 1
 Culvert 5' north of Survey line 4 @
 185' from line 1 (West)
 NL3 " 30 ft South of SL4
 @ 183 ft from Survey line 1
 width of ditch North of New Deep Rd
 ~10'
 Culvert under Heavy Bucket Rd to Lagoon
 26' W x 20' north of O point Survey line 1
 Exposed Survey line 4 East
 Sample point SL3
 33' East 25' N of o point west
 Survey line 4 and 1
 Ditch Survey line 4 to OL1 365.5'
 @ 185'

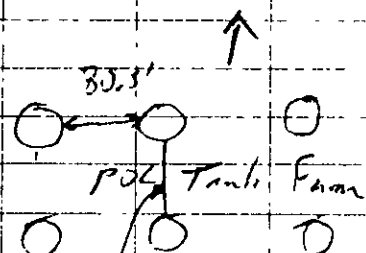


Eastern Dump Overflow

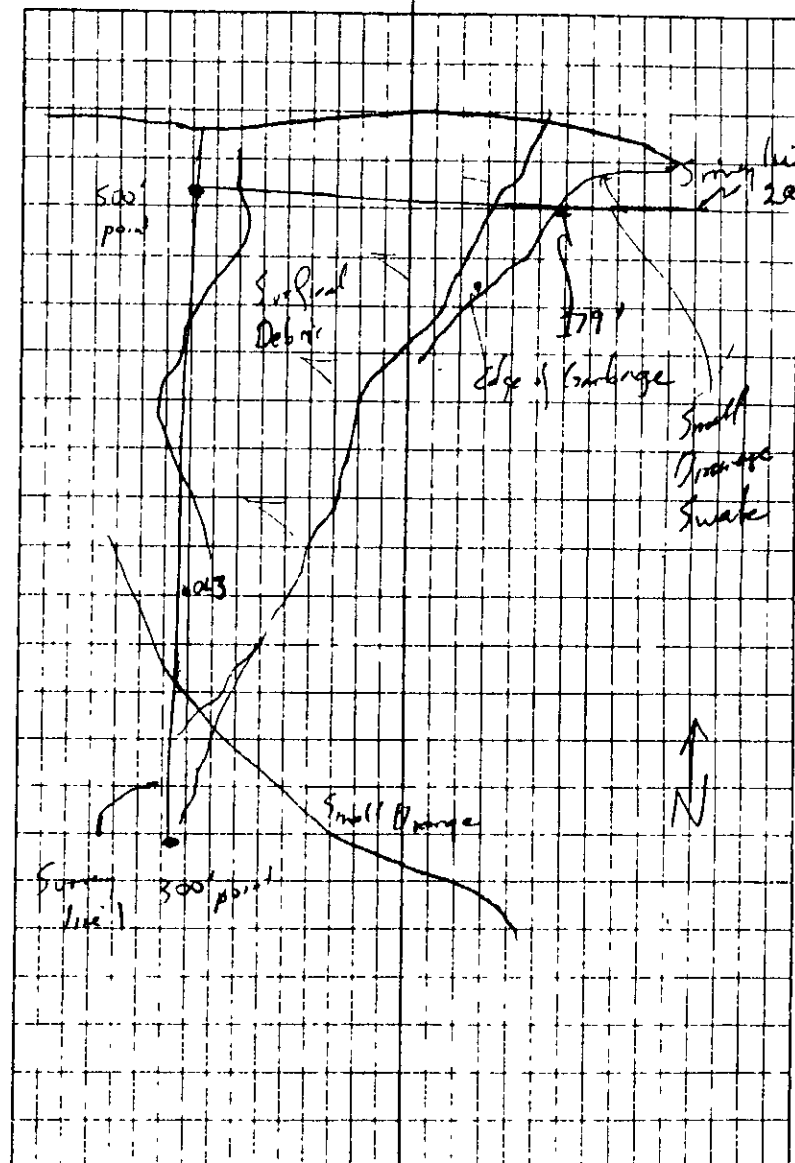
Survey line 2a 179' East
to top of small drainage Swale

Drainage swale 10' wide 3' deep

Scale Check for Map



Measured by J Hunter K Shepard



New Landfill

Extended Survey line 4 to S49° from
 0 Survey line 1 to NW corner of
 Landfill

Wedge 307'
 Wedge 300'

Edge
 Edge 200 305'

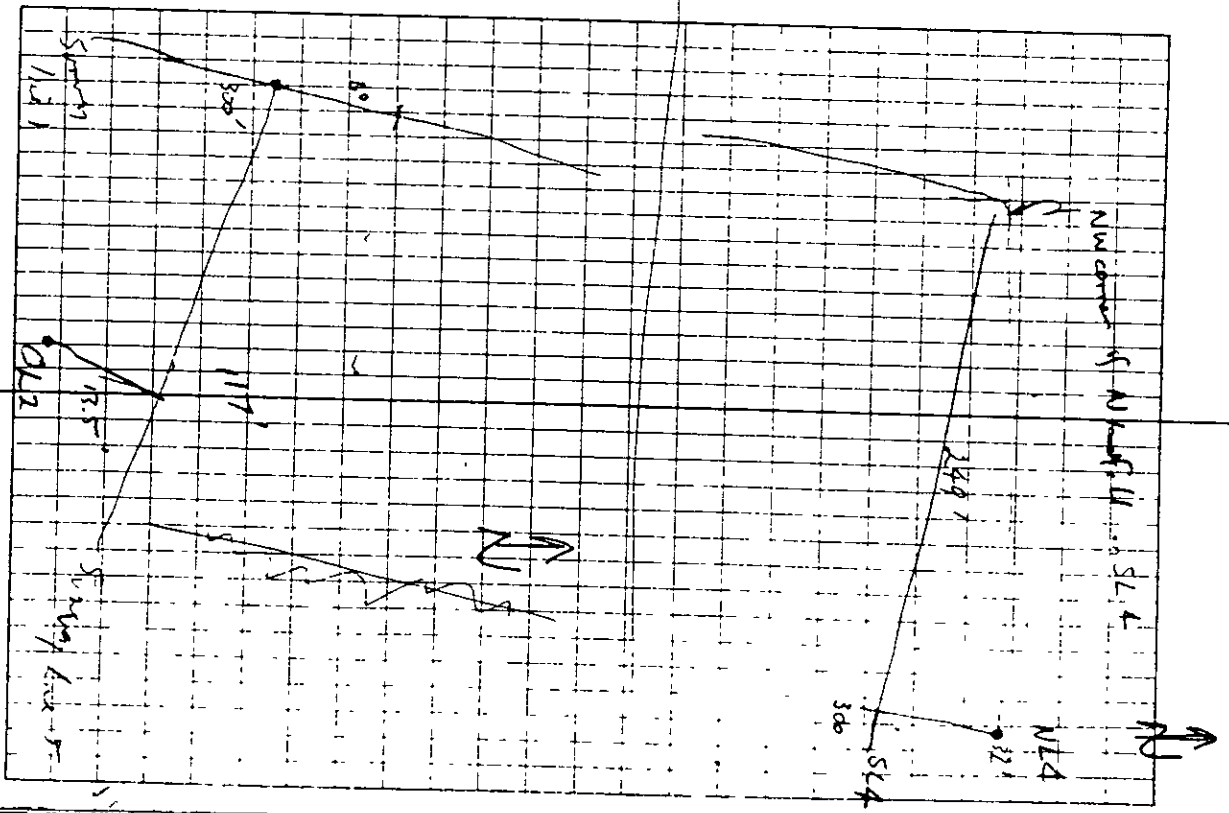
Survey line 5

Line end from 1 90° @ 300' mark

to start 117' then still 13.5' to

DL2

DL2 is in bottom of drainage to
 east of old landfill debris



Old Landfill Verticals

Photographs 12, 13, 14 Debris along bluff depicting garbage eroding from face

Photo 15 Stake OLS looking toward garbage bluff

Photo 16 Looking downstream the with western drainage & ocean, bluff on west side face of debris

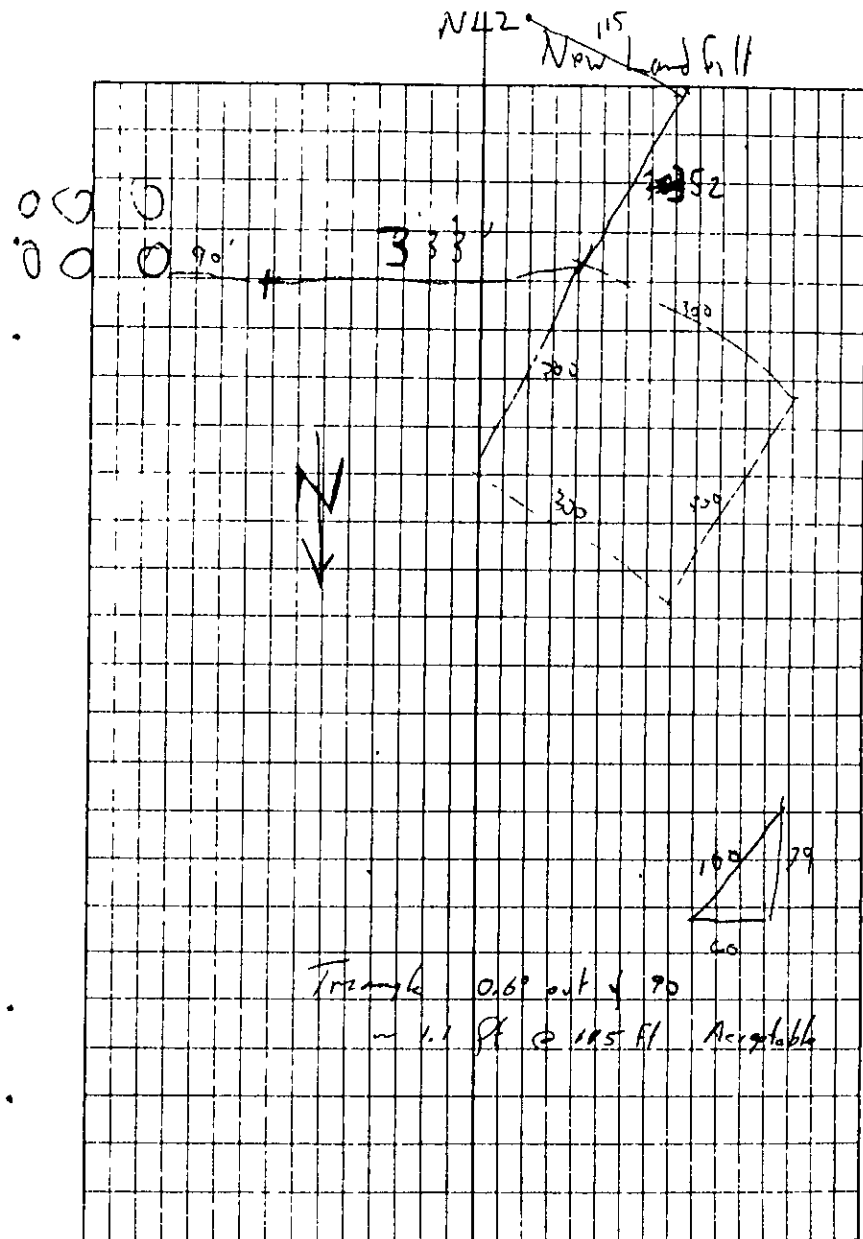
See R. Spencer Notes for plot of bluff

Drainage (western)

Gradient: 58' per 80'

Aug 19 1900 All 4 of us sat down & put together all the survey notes & made a map. Most fit well, few things missing.

Need: Tin in I Mastic Contaminated Ditch Notes
3 new contaminated locations



Aug 20 HNU Corbin 500820 10.2 EV bulb

0 setting adjusted 13.8V check good
6.43 spec setting (last 79 ppm red bottle)

0835 Started Digging Test pit 1 (5 m. to level)

South side of New Landfill

0-2" live organic mat w/ occasional gravel

2-2" brown organic mat with water flow (macro pore)

2-15" fine sand w/ lots of organics, no flowing

water, but saturated

15"-22" gray fine sand with trace of silt

after open for 5 months sand started to collapse

from water flow, also evidence of channeling

and piping

25" - Formed first (might have a little more in the air)

layers (1-2") (gray fine sand with trace of

silt, no visible ice

Hile finished at 9:12 let stay open for water

flow. 9:20 sand just of water out at 14"

Light water depth @ 9:27 " 4" (18" depth)

Photo 17 @ 9:16 looking at west end of pit

Volume of H₂O

Top surface 10' square

18.6.11 8:32

4"

4-14" point w/ some live reds, did not get good

Test Pit 2 E side of New Landfill (5 m. to locate)

0841 Started digging hole

0948 finished digging

0-1" live organic mat with some gravel, silt

1"-3" brown gray sandy organics w/ occasional gravel silt

3"-5" dark brown organic mat w/ macro pore flow

5"-16" gray fine sand w/ very occasional gravel, saturated

16"-22" dark brown organic mat w/ macro pore flow

22" clear ice

HNU reading 0949 - background

Bottom of Hile flat 10" x 7"

1003 - 5" water in bottom of hole, some

silt collapsed in (3X volume?)

Photo 18 @ 9:58 looking at SW end of pit

Test Pit 3 W side of New Landfill (5 m. to locate)

1018 started digging

Surface water flow

1018 started digging

1018 started digging

1018 started digging

1018 started digging

1018 started digging

1018 started digging

1018 started digging

1018 started digging

Test pit 3 cont

Finished excavation @ 1027 Approx 1/4"

H₂O is better after boiling

Photo 19 @ 10:34 SW end of p.t.

Bottom area squared vertically Area 10" x 20"
10.42 6 1/2" water in bottom of Hole. water
has organic sheen on surface

TEST P₁₇ 4, in lower area ~~8~~ N of new land fill
(JH water location) no surface water

0-8" vegetative mat

8' permafrost, organic mat ~ 50% ice

Finished Hole 1058 Water Flow into hole

slightly near surface 1" under 7' x 12" @ 11/13

Backfilled hole 11.15

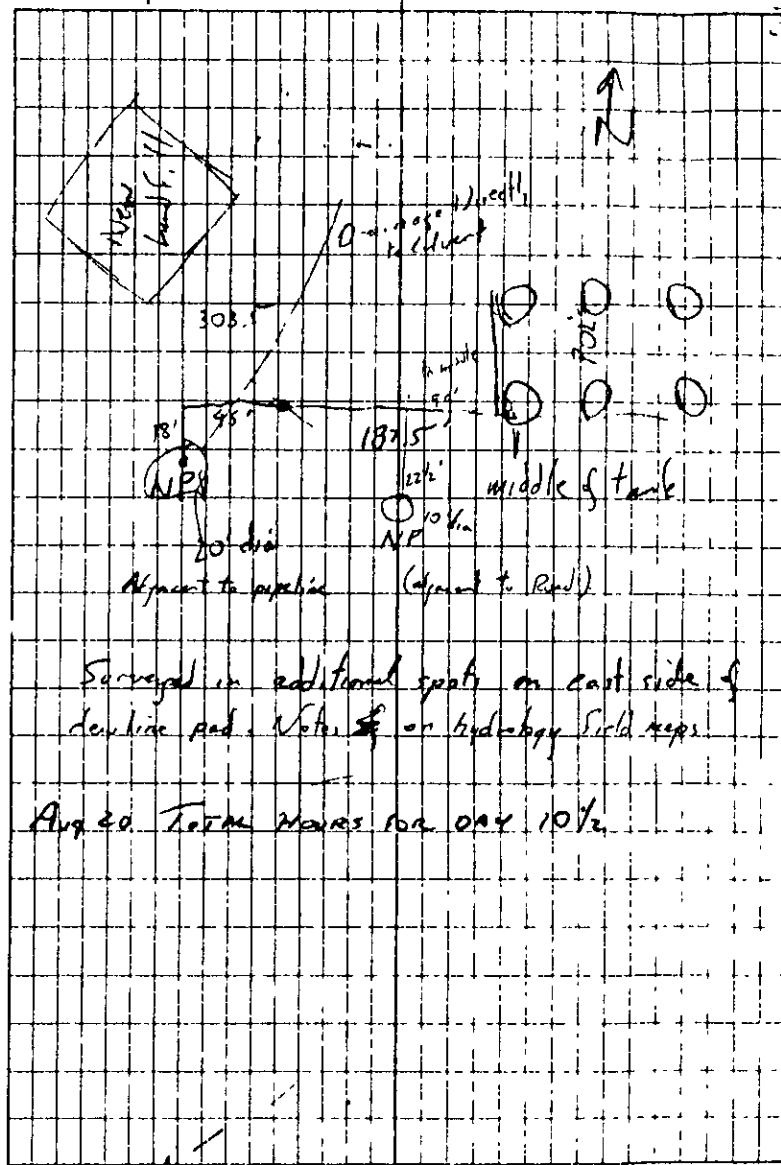
Test Pit 4a ^{no surface water} in high area (J Mun. locate

0-9" vegetative mat

9" permafrost brown silt, no visible ice

Finished digging 11:05

Survey "Fostering Hope" NP = new Pollution



Surveyed in additional spots on east side of
Leachine pad. Notes ~~of~~ on hydrology field reps.

Aug 20. Total Moves for day $10\frac{1}{2}$

水嘉

Aug 21

Kelly & I started water sampling 0800

D. L. Savage Logson

POH storage

Old landfill

2 sample locations new landfill

Kelly has notes on samples

Finished 1830

Started packing & sending samples in ~~box~~

D. L. Ship Finished @ 2200

Total Hrs for day 14

Aug 22

Finished packing stuff @ Better Island & united

for Airplanes

Arrived land 2230

6 hrs sampling 4 hrs Travel

Aug 23

Spent morning trying to put together notes

From QAPP, Work Plan & 50w & place

stakes for the POH area & Large Fuel Spill

Area

After lunch Lyndon Parker (Station Manager)

took us out to the Hauling land fill Saw

2 Polar Bears

Also had the mechanic show us a fuel spill

it's not near anything and we supposed to

1 sample Manual Fuel Storage without 1/2 in sample

to the beach Fuel storage

Stashed Fuel Tanker & Old Landfill site

Spent 1 hr organizing bottles for sampling

Aug 23 Total 10 hrs Sampling / morning

Aug 24

Calibrate HNU 164414

Span 9.00 9.00 for 70 ppm (R) Bottle

0 set Battery Full charge

P.H. meter 0230977

STD 1 P.H. 12.00 4.00 10' @ -23.5°C

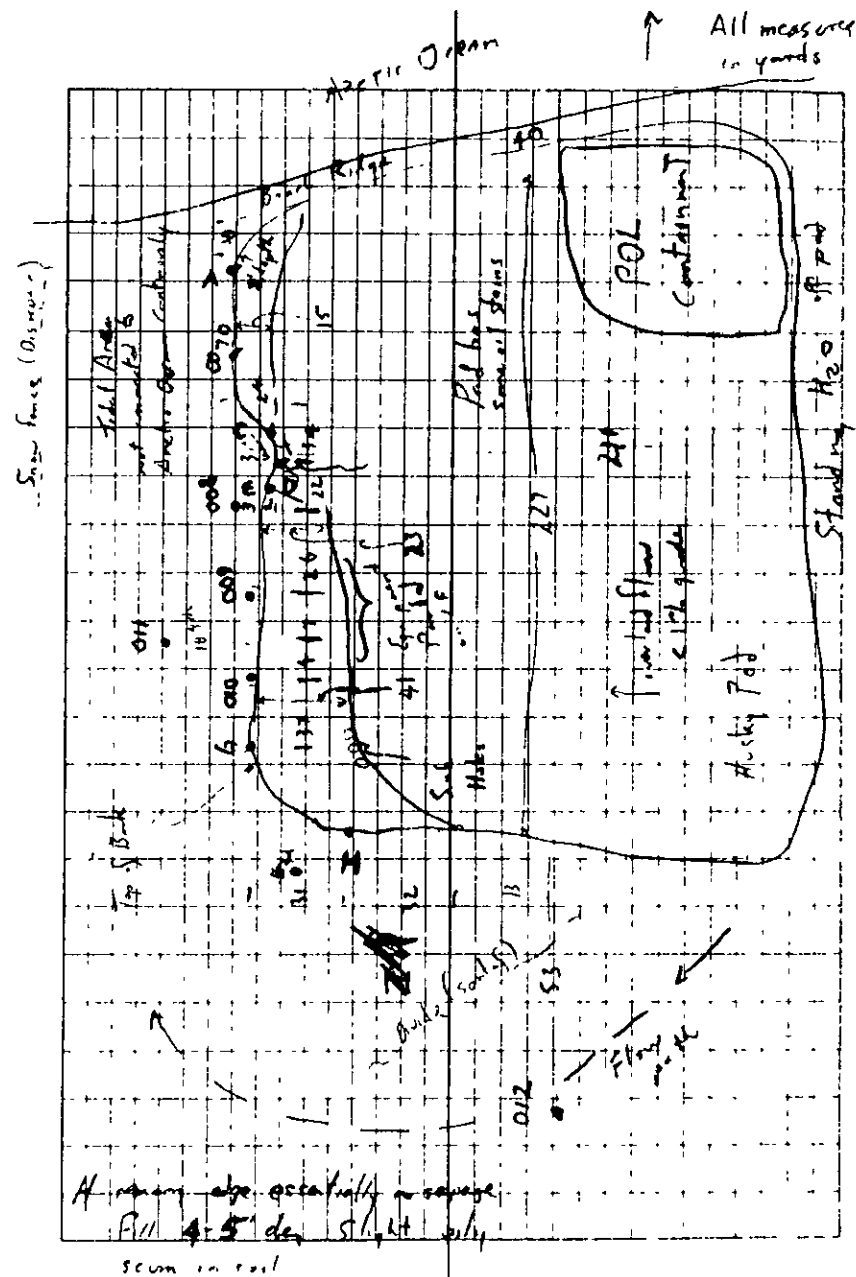
STD 2 P.H. 12.00 - Temp 10' @ way off

P.H. 7 - 7.05 @ -2.40

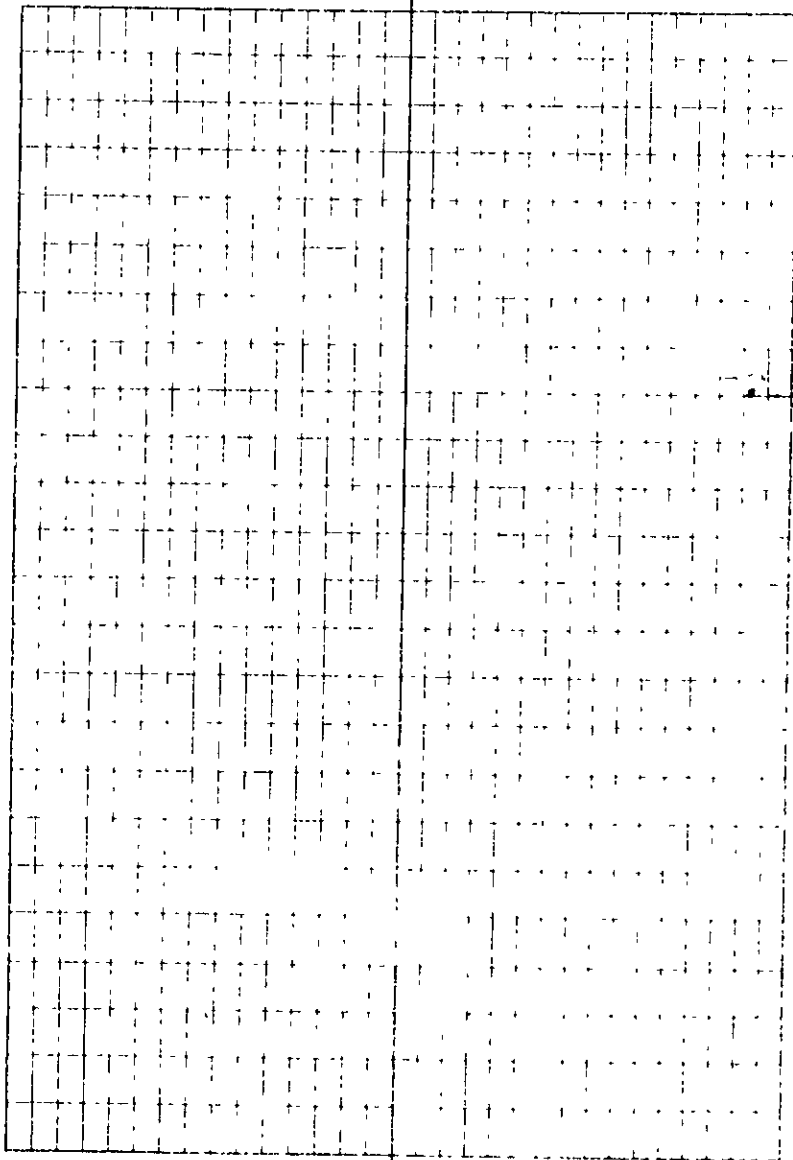
DRO showed High Landfill site

Hydrology Husky Landfill

- A Fill depth $\approx 3'$ Seepage est $1 \text{ gpm}/30'$ length
total length 29 yds Seepage has oil sheen
Soil not softened
- B Fill depth $\approx 3'$ Seepage est $1 \text{ gpm}/60'$ length
total length 29 yds Seepage has oil sheen Soil not
softened
- C Fill depth $\approx 2'$ Seepage est $1 \text{ gpm}/30'$ length
total length 20 yds Seepage has oil sheen
Soil not softened
- D Drainage, fill depth $\approx 4'$ Flow rate
 $2 \text{ ft}^3/\text{Sec} \times 0.2 \times 0.04'$ Drains 17 yds of
bluff est $1 \text{ gpm}/30'$ (check data) Sheen on
seep
- E Series of 3 small seeps draining to 008
Total of 3 $\approx 1 \text{ gpm}$ over 10 yds of bench
Sheen on seep
- F Between 008 & 009 est $1 \text{ gpm}/30 \text{ ft}$ Sheen on
seep 7 + 26 yds Total. More concentrated oil sheen
some softening of soils Fill depth $\approx 4 - 5 \text{ ft}$
- G 40 yds Seepage $1 \text{ gpm}/100 \text{ ft}$ Very slight sheen
Fill depth 4'



46 310

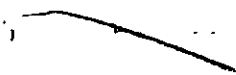


56.1

I off pad flow
29/ 5500 x 0.09 x 0.07
This flow is all of flow around SW
corner of pad, the flow is by seepage

Photo #30 looking S along Face of 45
Well #126 at 15/2011

Aug 24 Total 43 km



Aug 25 Calibrate HNU

Serial 16444

Battery ✓

Stability 0 calibration good

Rad Bottle Span setting 8.91 for 70ppm

Serial 500320

Battery ✓

Stability 0 calibration adjusted

Rad Bottle Span setting 6.54 for 70ppm

Sampling POW-1 FS-1 1060-50-001

Photo 3031

1 soil sample 16 g 418.1 / 02216

soil: brn gravelly sand (sat) HNU bkgnd

Sample Time 0938

POW-1 FS-3 1060-50-003

Photo 32

1 soil sample 16 g 418.1 / 02216

soil: red brn sandy gravel (sat) HNU bkgnd

Sample time 945

POW-1 FS-4 1060-50-004

Photo 33

1 soil sample 16 g 418.1 / 02216

soil: Reddish brn sandy gravel (sat) HNU bkgnd

Sample Time 955

POW-1 FS-2 1060-50-002

Photo 34

1 soil sample 16 g 418.1 / 02216

soil: ~~black~~ gravelly sand sat HNU bkgnd

Sample Time 1005

POW-1 FS-3 1060-50-018

Robin took photo

1 soil sample 418.1

1 soil duplicate 418.1 02216

} 2 16 g
} jars

soil: gray gravelly sand (sat) w/ organic
present HNU bkgnd

Sample Time 1030

POW-1 FS-2 1060-50-017

Robin took photo

1 soil sample 418.1 02216

16 g jar

soil: Black gravelly sand w/ organic / saturated

Sample Time 1035 HNU bkgnd

Prudhoe Bay Hotel 659-2449
Mary Ann

1997

6569-50-3

55-72

Each

Feb 1, 1907

4-105-157

30

11/11/11

Handwritten signature: *Handwritten signature*

7-135

K. Susewind
Field Notes
DEWLINE
Aug 1988

8/8



TRANSIT

NOTEBOOK NO. 301

16 AUG 88

1430 - MEET TO DISCUSS plan of
OPERATIONS.

AT THIS POINT WE HAVE ARRIVED
ON SITE @ BARTER ISLAND.

WE COULD ONLY GET A PORTION
OF OUR GEAR HERE. MARTIN

AIR WAS EXPECTING 400 LBS OF
GEAR; WE HAD 1300 LBS, THE

REST OF OUR GEAR WILL BE
COMING AS SOON MARTIN AIR
CAN FREE SOMEONE, THEY ARE VERY
BUSY AND IT MAY BE AS LATE
AS TOMORROW.

- PAUL MOLL (STATION CHIEF) HAS
INFORMED US THAT WE WILL NOT
BE ABLE TO GO TO CONEY UNTIL
MONDAY 8/22.

POINTS

- VEHICLE - LIMITED
- STAGING AREA
- CAPE SMYTH AIR

16 AUG 88 (CONT'D)

- INFORM MARTIN AIR WE WILL
NOT BE LEAVING UNTIL Monday 22nd

ASK ABOUT ADVANCE NOTICE
REQUIRED FOR Sampling Shipments.

- DRUMS

- DATE OF DEP? 8/22/88

640-9902. Will P.A. 1404

NEED CONTAINERS - 59AL buckets
" BARRELS

DEMO TEST

KITCHEN FOR ICE

1941 - CALL JOEL KUSHINS

VRCA ENVIRONMENTAL

Bullm. 26"

46 316

—CALL MARK SIMMS.

8/17/88 WED

0730 BREAKFAST

CHIL = BSL ✓

Smyth ✓

OFFICE

✓ REP

✓ CART 1100AM

Spec insert

✓ Filter

MARTIN AIR ✓

LAB ✓

CALL BACK

0700 NO ANSWER CAPE Smyth

- URCA - NO ONE IN. WHO

KNOWS ANYTHING ABOUT

PURCHASING BARRELS. CALL

BACK AND TALK TO

DYRUM OSTHOFF.

✓ CALL OFFICE BACK @ 10:30

LAB - WILL TRY TO WORK SOMETHING
OUT. CALL BACK @ 12:00 AM.
RISK FOR JULE HYAT.

MARTIN AIR will schedule
A CHARTER TOMORROW (8/18/88)
@ 8:00 PM.

1-2 P.M. TODAY he has A CHARTER
COMING. he will split w/ us.

Filter kit has not
been sent. ASKED. PLEASE TO
SEND IT ASAP

1105 - CALL URCA.

@ KUPARUK TILL 12:00

FRI AND MON delivery.

1442 JOEL Rushing

Ave H2O. AF. w/ Surge

in gear. BAK. Some sent

for Bullen

8/17/88

JOEL KUSHING IS TRYING TO
GET AUTHORIZATION FROM THE
AIRFORCE TO DISPOSE OF THE
DECON H₂O IN THE SEWAGE
SYSTEM. WE WILL CONTAINERIZE
THE MATERIAL UNTIL WE FIND OUT

1500 - CALL OFFICE

MARHAR FIT. IS - 7:25pm

REQ

ARRIVAL

CART

SPD

Filter Kit

DECON H₂O

Verbal Soe Fitzgerald

on Surge (w/ com)

- Lonely - LARGE OIL Spill

AREA CAN BE ^{USCAR 70} SPARKED &EVAPORATED the DECON H₂O

File 27.

18 JUNE 83

CALL TO MAKE PRIOR TO SAMPLING

- MARTIN AIR

- KIMIA JEAN ZIMMERMAN

0815 - CALIBRATE H-NUS.

164414

500320

BOTH HAVE 10 ZcV BULBS

CALIBRATED W/ ISOBUTYLENE

W/ EQUIVALENT BENZENE CONCENTRATIONS
OF 70 + 81 ppm.

BOTH UNITS CALIBRATED W/ BOTH
GRIDS

#164414 Span Pot = 7.42 ~~8.5~~

#500320 Span Pot = 6.84 ~~8.5~~

0915

CALL JEAN ZIMMERMAN AGAIN

CAN P.U. SAT MORNING.

COURIER QUICK SHIP.

Tell JEAN we would inform
her of flight numbers and times
of ARRIVAL AS SOON AS they
could be determined.

17 Aug 88

We currently have one
cask of ice core samples for
BARTLE Island ready to go.
We were weathered in all day
yesterday.

I've called MARTIN AIR; they
think they will be able to
get the samples out today
but can't give us a time.
We will call them @ Lunch
to get a better schedule.
As a contingency Joel Kushnir
can take the samples tomorrow.

I will call LAB AS SOON AS
we can determine the arrival
time of the samples in
Denver.

1310 HRS: Samples went out on MARTIN
AIR @ 10.45 A.M. MARTY (MARTIN
AIR pilot) SAID HE WOULD GET
THE SAMPLES TO ALASKA AIRLINES

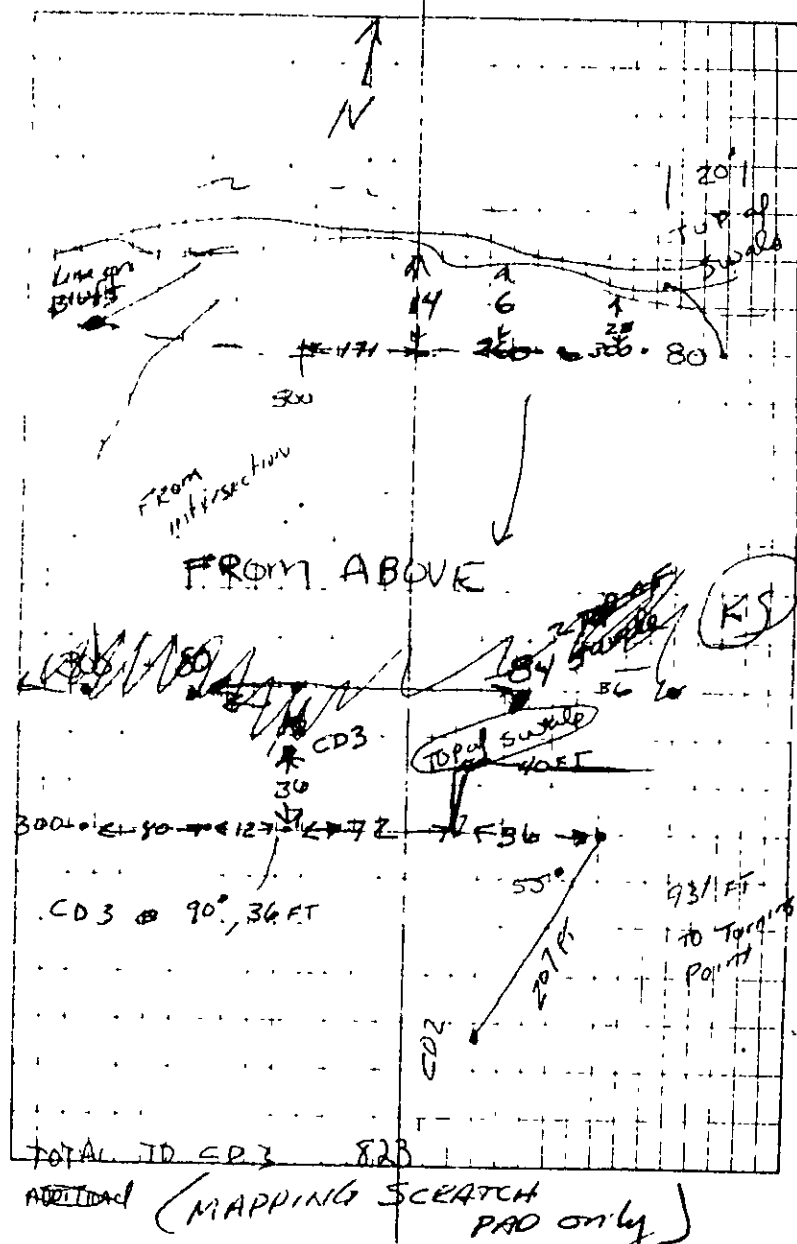
AND put them on the 5:45 PM
Flight FROM DENVER TO Anchorage
I called AK AIRLINES CARGO (BOTH
ANCHORAGE AND DENVER) THEY WILL
GET THE SAMPLES ON A FLIGHT
TO SEATTLE TONIGHT AND TO
DENVER TOMORROW MORNING @
0530 HRS.

I CALLED RMA AND TALKED TO
JEAN ZIMMERMAN, SHE SAID SHE
WOULD SEE THAT SOMEONE GETS
THE SAMPLES TOMORROW. SHE
ASKED THAT WE CALL HER
SAT MORNING TO DISCUSS THE
SAMPLES AND SEE THAT THEY HAVE
ARRIVED WITHOUT BREAKAGE.

20 Aug 88

0820 - CALL RMA TO DISCUSS
Samples they should have received
this AM AND tell them to
expect more Monday eve
cont. Flight 1214 ARRIVE 9:15pm
They (RMA) HAVE NOT GOT THE
COOLER. They SAID it should BE
@ UNITED AIR BUT they HAVE NOT
BEEN ABLE TO GET CONFIRMATION
OF THAT. I GAVE AIRBILL # 7518-6920

- CALLED MARTIN AIR AND SET UP
A CHARTER FOR 21 AUG 88, SUN
@ 9-10 p.m. They Requested we
continue tomorrow



20 AUG CONT'D

BYS - CALLED RMA AND SPOKE W/
MAUREEN McDEVITT, they have
NOT RECEIVED THE SAMPLES.

I GAVE HER THE AIRBILL #
AND ASKED HER TO TRY
TO TRACK IT FROM HER END.

②
CALLED AK AIRLINES (Dental)
they said the cooler was too
heavy, 117 TO GO AS GOLD STEAK
AND SO WENT AS PRIORITY (ARGO),
BILL # 027-5CC-1177-2224

- CALLED AK (ARGO) (SEATTLE)
1-800-225-2752

Transferred 2:45 pm. to United
United Airlines Seattle 206-433-4000
1-800-631-1500 ~~206~~

U/A
Received @ 2:58 in Seattle
5:00 pm - 10:22 pm
Flt # 208.

Scorpius The. cooler will arrive 15
10:22 pm.
- Called RMA (Maureen McDevitt)
who will try to receive the
samples tomorrow A.M.

21 Aug
0941 ALL NS. Samples TODAY
ARRIVE @ SL 3

TAKE SHV, W. C. 1. 0001
● 0945
pH 7.1 T = 5.5 °C
Sal = 0.8 ‰ 80 μmhos
0.

1010 ARRIVE SL-1
Sample # 002-0001
418-1, 8080, 9132, 6010
Sample Time 1015
pH = 8.76 T = 5.5 °C
Sal = 0.8 ‰ C = 850 μmhos

1040 ARRIVE SL 2
Sample # 003-0001
418-1, 8080, 9132, 6010
Sample Time 1045
pH 8.71 T = 5.0
Sal 0.8 ‰ C = 700 μmhos

1105 - TOOK TODAY'S EQUIP BAKR
8010, 8080, 418-1, 8080

21 AUG CONT D

1126 - ARRIVE PB1 TAKE Sample

013-0002, 418.1

pH = 7.05 C = 6.00

SAL = 0.3‰ T = 5.0

Sample TIME = 1130 HRS

1136 TOOK AMBIENT CONDITIONS

7010/8020 @ LOCATION PB2

1135 ARRIVE PB2

TOOK Sample 014-0002

418.1 Sample TIME 1145

pH = 6.82 C = 5.80 umhos

SAL = 0.2‰ T = 5.0 °C

1201 ARRIVE @ PB3 0002

TOOK Sample 015-0002

Sample TIME 1205

418.1

pH = 7.19 C = 440 umhos

SAL = 0.3‰ T = 5.0 °C

1219 - ARRIVE CD4

TOOK Sample 216-0002 4118.1

Sample TIME 1220

pH = 6.89 C = 8.50 umhos

SAL = 0.7‰ T = 5.0 °C

1254 - ARRIVE @ OL1

TOOK Sample

001-0002 Sample TIME 1305

pH = 7.16 T = 5.0 °C

C = 750 umhos SAL = 0.5‰

418.1, 8080, 6010

1311 - ARRIVE @ OL3

TOOK Sample 003-0001

Sample TIME 1315 hrs

418.1, 8080, 6010

pH = 7.54

SAL = 0.7‰

C = 1050

T = 6.0 °C

21 AUG 88 CONT'D

1325 - ARRIVE @ DLZ

TOOK Sample 005 - 0002

8080, 418.1, 6010, 9137

Sample Time 1335

PH = 7.63 T = 6°C

C = 820 $\mu\text{mho/cm}$ SAL = 0.7‰

1410 - ARRIVE @ NLZ

Collected Sample 010 - 0002

Sample time 1415

8010, 8020, 418.1, 8080, 6010

PH = 7.67

T = 7.0

C = 475

SAL = 0.4‰

1430 - ARRIVE @ NLZ

collected Sample 009 - 0002

in MS/MSD Duplicate

Sample Time 1440

8010, 8020, 8080, 418.1, 6010

PH = 7.45 T = 7.0°C

C = 520 $\mu\text{mho/cm}$ SAL = 0.3‰

1724 ARRIVE @ DLZ

Sample # 007 - 0002

8080, 418.1, 6010

Sample Time 1730 HRS

PH = 7.9 T = 8°C

C = 700 $\mu\text{mho/cm}$ SAL = 0.4‰

1740 ARRIVE @ DLZ

Sample # 006 - 0002

8080, 418.1, 6010, 9137

Sample time 1745 HRS

PH = 8.06 T = 7.0

C = 780 $\mu\text{mho/cm}$ SAL = 0.8‰

23 Aug 88

- 2 coolers ARE IN DENVER
READY FOR P.U. The other
4 coolers are in Seattle and
will BE TRANSFERRED ASAP.

- 0945 - CALL RMA (M. McDevitt) TOLD
her THAT 2 coolers were Ready
for P.U. IN Denver and 4 would
be ARRIVING some time today.
She SAID they would pickup the
samples AND ASKED that we
CALL her w/ info on other 4
coolers ASAP.
She also SAID that all the soil
samples had been received and
there was no breakage.

We ARRIVED in Lonely @
Approx. 2230 HRS LAST night.

- 1345 - CALLED AK AIRLINES
They transferred the coolers
to United @ 1213 APT

CALL UNITED -

WILL ARRIVE ANKOV ON
Flight 242 @ 7:08pm
1177-2390

By END OF DAY WE HAVE STAKED ALL
SAMPLING LOCATIONS w/ the exception
of the HUSKY LANDFILL. We went to
this LANDFILL as well but biological
HAZARDS prevented us from staking
the AREA (i.e. Polar Bears).

- We HAVE SORTED ALL SAMPLING
BOTTLES AND WILL BEGIN SAMPLING
TOMORROW.

HL-10
FS-10
PS-8
SO-4
OL-2

24 AUG 88

0800 - CALL MARTIN AIR

THEY CANT GET IN BEFORE TOMORROW
AFTERNOON

- CALL CAPE SMYTH, they will try
TO GET HERE TODAY, ASKED THAT
I CALL BACK TO CONFIRM WHEN
GET A TIME

1030 ARRIVE HUSKY LANDFILL

1430 - CALL RMA

THEY HAVE RECEIVED ALL SAMPLES

- CALL CAPE SMYTH AIR, they will
be in sometime after 2000
- Sampled and shipped all samples
from the HUSKY LANDFILL

25 AUG 88

0800 - CALL CAPE Smyth AIR to Confirm
A CHARTER FOR TONIGHT

0915 ARRIVED Fuel spill site
5 and 7. Begin Logging

0-1.4 BROWN FINE TO COARSE
SILT w/ some GRAVEL. No visible
contamination. Moist. Top
1/2 inch frozen. H-NH = B.G.

Becomes wet @ 1.2-1.4

1.4-1.6 BLACK/BROWN ORGANIC SILT
to silty organics. NVC. A.A.U.
B.G. DAMP

1.6-2.0 GREY SILT w/ some very
fine SAND. NVC. H-NH = B.G. DAMP
TOOK SAMPLE 005 - 0001 (SIL) -
from 1.5 - 1.8 FT. H.B.I.
Sample time 0926.

2.0-2.5 BROWN SILT w/ some
organics. NVC. DAMP. H-NH = B.G.

2.5-2.7 ICE. Assume a massive
ice crystal which appears in
major cutting & sawings.

T.D 2.7 FT

1015 - ARRIVED FSG/B
Begin Logging

2.0-2.3 TAN/BROWN medium SILT
w/ some GRAVEL. DAMP. TO 1.5 FT.
NVC. H-NH = B.G.
Becomes wet @ 2.0 FT

2.3-2.5 ORGANIC MATT, as mosses
and BRUSHES w/ some SILT. Moist.
NVC. H-NH = B.G.

2.5-3.0 GREY SILT DAMP - Moist
NVC. H-NH = B.G.

3.0 - FROZEN
Sample 006-0001 (SIL)
from 2.5-2.7 FT. H-NH = B.G.
Sample Time = 1020

25 AUG 88 (CONT'D).

1115 - AFTER FOLLOWING ECLIPSE
BORING 005 AND ± 2m of
STANDING H₂O SAMPLE #
005-0002 (H₂O)
WILL. THICKEN to be analyzed
FOR 4/10 1 TAIL.

1140 TOOK FIELD (AMBIENT COND'TIONS)
BLANK @ 005 SITE

1145 TOOK SAMPLE 006-0002 (H₂O)
WATER WAS STANDING 1/2 FT Deep

1205 TOOK SAMPLE

106-D-NL (LIL)
GN-88 (LIL)

FROM BEACH @ SHORE (LIL) -
(LIL) LIL FOR SIL

4151, 8750, 3010, 3010

T = 0.3

SAL = 0.9 ‰

C = 780 $\mu\text{mho/cm}$ pH = 8.27

SAMPLE 1060-50-013

GS-88-0001 (SOIL)

BROWN GRAYEY SAND & SLIGHT
FUEL ODOR H-NH = 25 ppm
UJET.

SAMPLE TIME 12:20 HRS

PACKED SAMPLES AND GEAR
PLANE WAS WEATHERED OUT

26 AUG 88

0150 - CALL CAPE STRICH AIR DISPATCH
 SAID TO CALL DENVER
 WILL TRY AROUND NOON, but he is
 still uncontacted in.

~~John Smith~~
 (K.)
~~John Smith~~
 (K.)

- CALL AK AIR CARGO
 Waybills 1518-7001 }
 1225-2995 } Husky "AMT"
 1224-1272 } examples

Due in to Denver on Cont. Flight 62
 Arrive Denver 9:45 AM.

Cont Denver - 1-800-638-7327
 - 376-3700

CALL CONT CARGO DENVER T-
 NO TRACING ON any papers
 SAID TO CHECK AGAIN IN 1 HR -

- CALLED RMA AND TALKED TO
 JENN ZIMMERMAN, TOLD HER TO
 E-PE 1 3 COPIES ON CONT. H 62
 AND 115 0945 AND GAVE HER THE
 WAY OUT AS

CAPE SMYTH - BARROW, 852-8333
A 500.00

MARK AIR PASS - 243-6275
Flight # 16
6:40 dep
10:00 per

SAT 88300334-0205 (21)
 Sun 902755-3701 (21)
 Mon " " (8)
 Tues " " 11 1/2
 Wed " " 7 1/2

5 mob
 5 1/2 3301

Thurs 12 - 3301

FRI -
 4-3301

Sun 10 1/2
 Sun 14
 Mon 14

Ship 9-45 AM F 14h
 Arrive Denver 9:15 pm.

D Graham 34-6146

Cont 1214
 659-2270 Smith
 659-2270 Smith

8/12 3 0 - B...

MARTIN AIR (DH) 659-2544
 (FBX) 451-0811
 (CHARLIE SMITH)
 CAPE SMITH - 646-6820
 (Mark Simms)
 AK AIR (DH) 659-2688

URCA ENVIRO - 659-2762
 (BYRON GETHOFF)

RMA 302-421-6611
 HARRIS MIDDLETON
 JEAN ZIMMERMAN
 (H) 303-233-7295
 Clear - 243-2360

RMA weekend

N 1950 M - Smith 207
 Land 2-791-8001

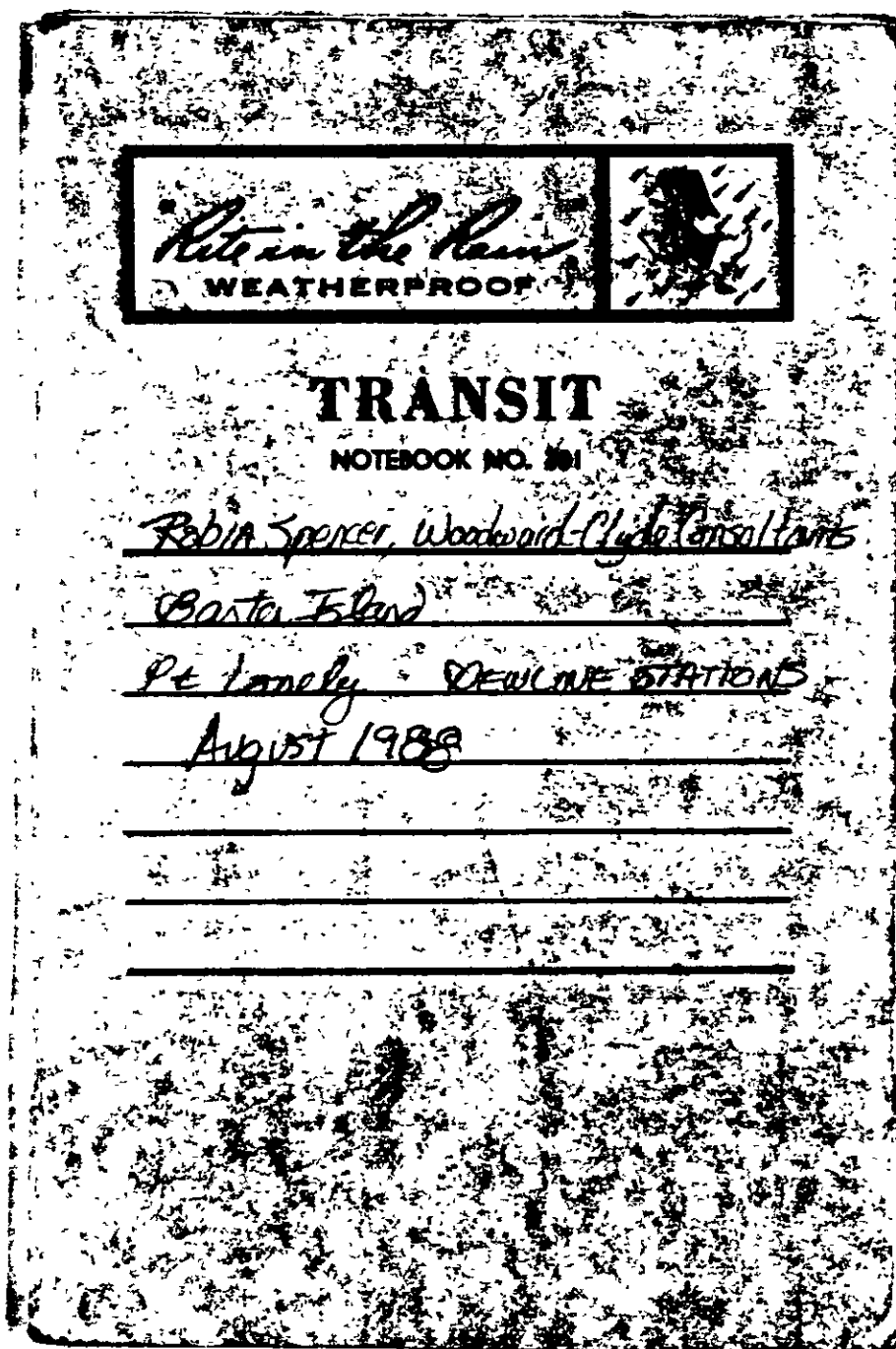
46 . 334

R Spencer

Field Notes

DEWLINE

Aug 1988



August 16

13:10 arrive at site. Met by Paul Moll

Earlier: 6:45 meet at WCC - Anchorage.

7:00 to Airport w/ Mobley, J. Munter

8:00 - 13:10 Travel to Bartel Island.

14:20 Meeting of WCC staff to outline activities

J. Speno

46 335

Items to discuss w/ P. Moll

- camera use - not inside on antenna
- sewage - amount ^{2000 gals/mo. etc.}
Know how much waste is brought in. all goes to Kaplan.
- vehicle
- staging area
- ascents to sites
- problems w/ flagging stakes
- how to get water?
- "dispose of debris according"
- ice packs in freezer in dining room

J. Speno

Aug 17 41° bright, partly cloudy
Meet at 7:00 for breakfast. Discuss day's plan.

Tim - meet w/ sewage man & Katorik mayor

Kelly - phone calls barrels, flights, lab

Robin/Kerth - inventory supplies - sort bottles

- Still some water bottles missing - will
come in later flight. Can send back some
extra supplies

1200 - State out contaminated ditch sample
location based on QAPP details.

CD1, CD2, CD3

1300 lunch

Kelly on phone calls after lunch

1400



State out sample locations. Team
of 4: Camera, Notes

Spencer

46 336

8-18-88

Sampling

800 - Get equipment together

840 - Decon.

930 - Sampling Notes taken by
J. Munter.

All soil samples taken

1600 Sample prep for shipping

1700 Guys return with more
samples.

(Comm) - Inventory, clean, tape over
label, put on custody seals,
seal in ziplock, tape shut.

1900 Package in styrofoam "socks"

Add ^{blue} dry ice. Chain of custody

- 3 forms for all samples -

includes 2 duplicates. Tape

↓
2030 up cooler.

Fin

46 337

8-19-88

Mapping

NW corner of NW tank - 90' to middle of road (w)

" " 185' to intersection

Middle of road to intersection 193'

Intersection to bluff 522'

Bluff to ~~the~~ Beaufort Sea 44.7'

Triangle made from 500' mark before bluff: 60' W, 80' S, 100' NW.

From

From 500' marker W across bluff 127'

From OL5 to Sea 63'

Another straight line from 300' mark

to N. 80' W 100' NW

From 286' to E top of bluff

at major OL drainage, across from 2nd swale.

From 286', 26' to OL1

This line is 6' N of OL1 which is on E side of drainage creek.

To OL5 is 186.5' N down creek.

Spencer

46 338

From intersection, another N, 185' to culvert.

To NL3 30' south from culvert on N side of road.

To culvert at SE corner of OL, 20' from intersection line (to south) 26' to intersection (E)

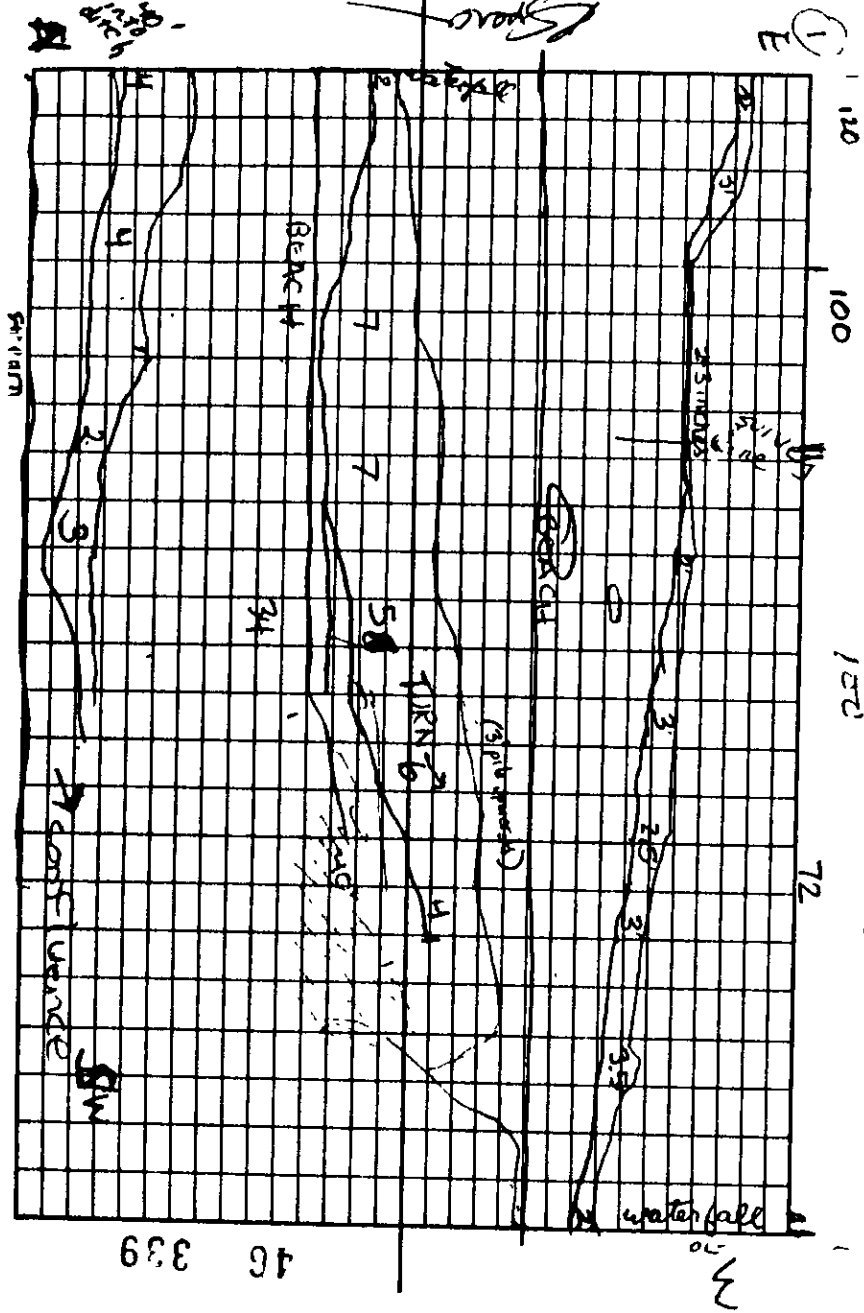
For control measure between NW POL Tank & the one immediately east (central N) is 80.5' ±

Measure surface debris area on East side of landfill. Along the bluff the stratigraphy of fill is evident - reaching from less than 1/2 foot to about 4 feet.

Spencer

8/19/88
 Profile of Visible Garbage
 at Vashant Sea

Spur



VI Field trip

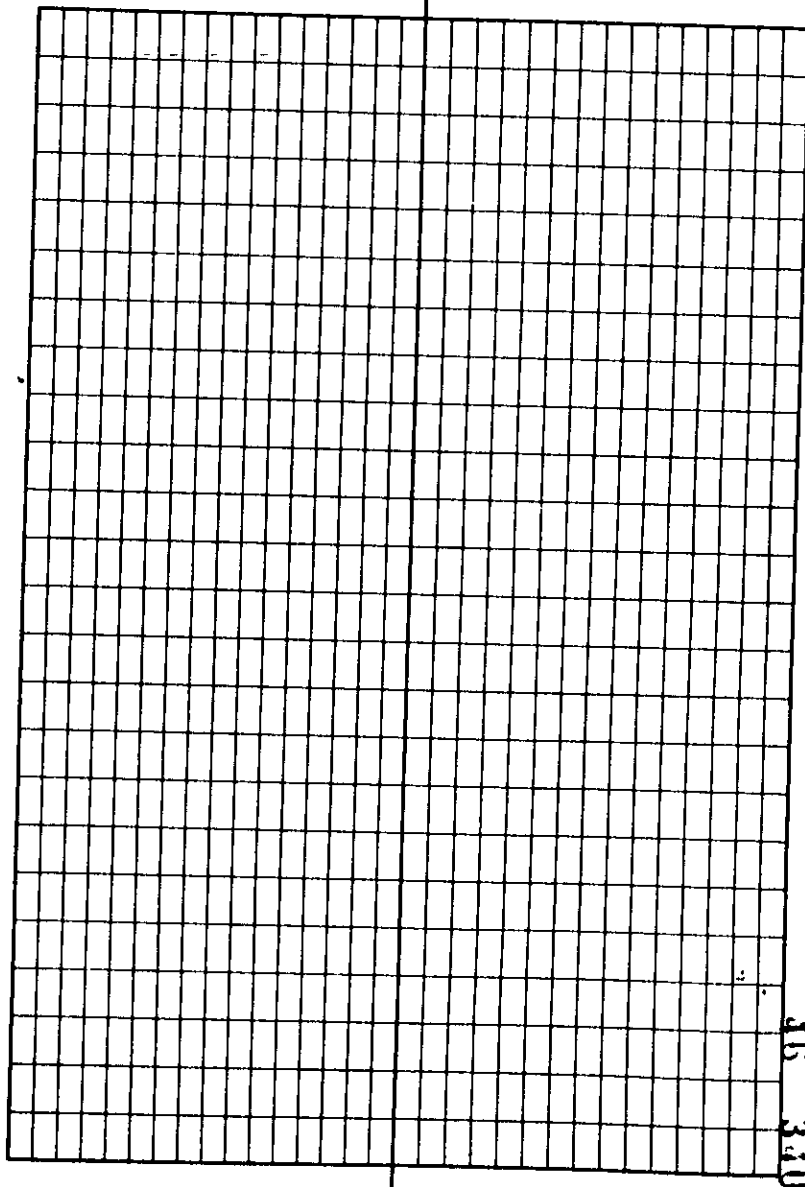
C.D. contaminated area

N & NW of culvert - Diesel

- take 1 water sample

- trench w/ shovel

SPENCER



45 340

8/21/88

ERO: pH calibration - 0230977

R&J STD 1 pH 4.00 at 25°C

STD 2 pH 10.01 at 25°C

SCT - 14803 red lined

K&C pH calibration - 0230976

STD 1 pH 4.00 at 25°C

STD 2 pH 10.01 at 25°C

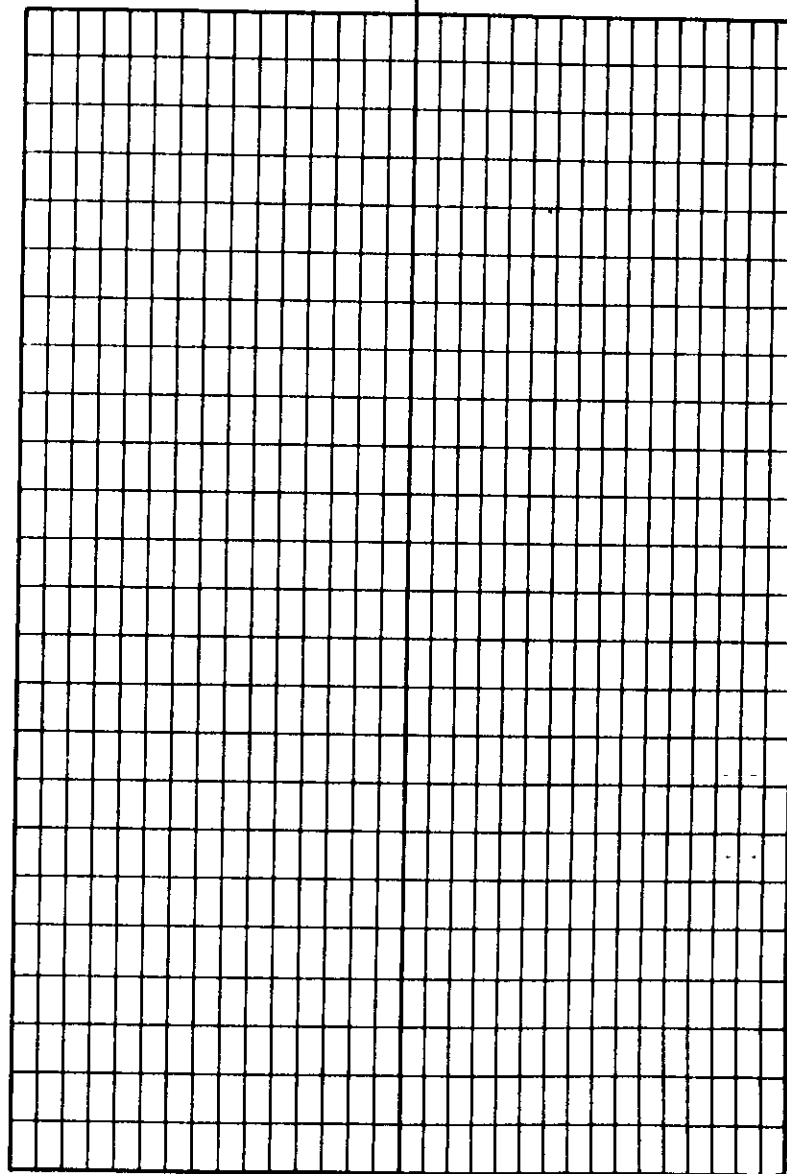
SCT - 13751 red lined

All Sampling notes in J. Munter's
Field record.

Work until 20:00

P. Spencer

46 341



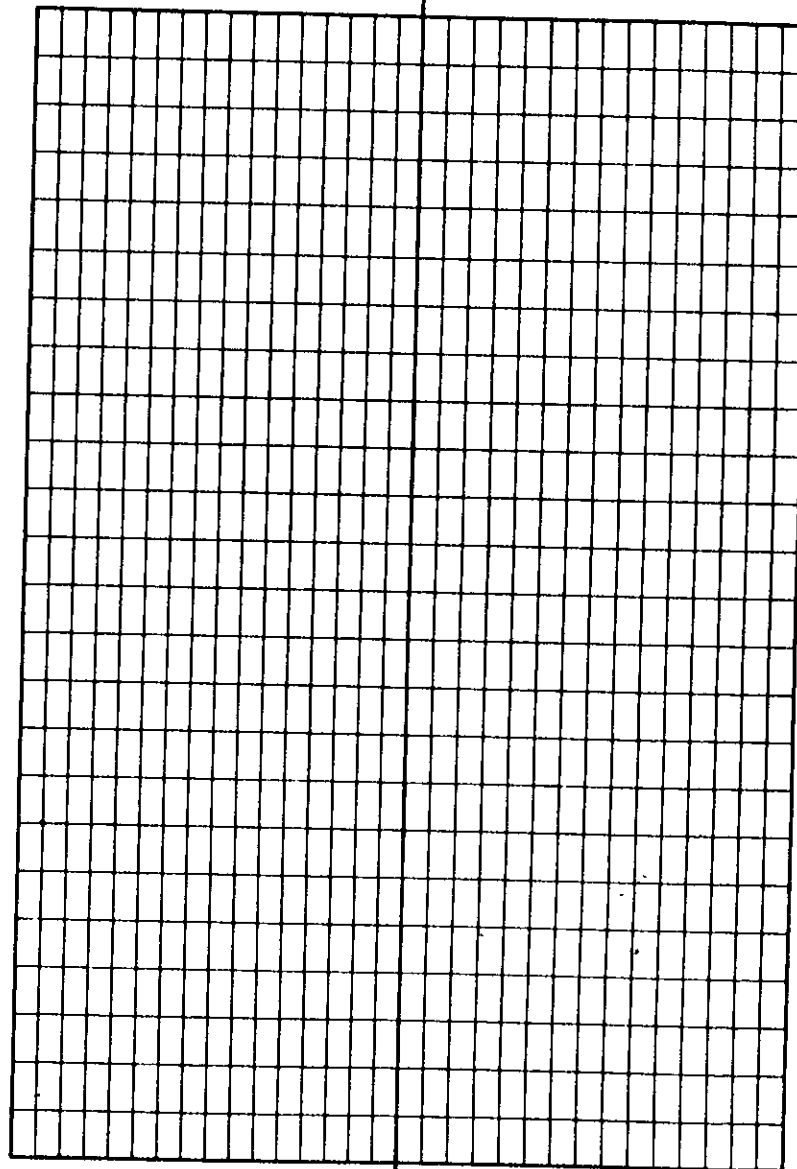
8/22/88

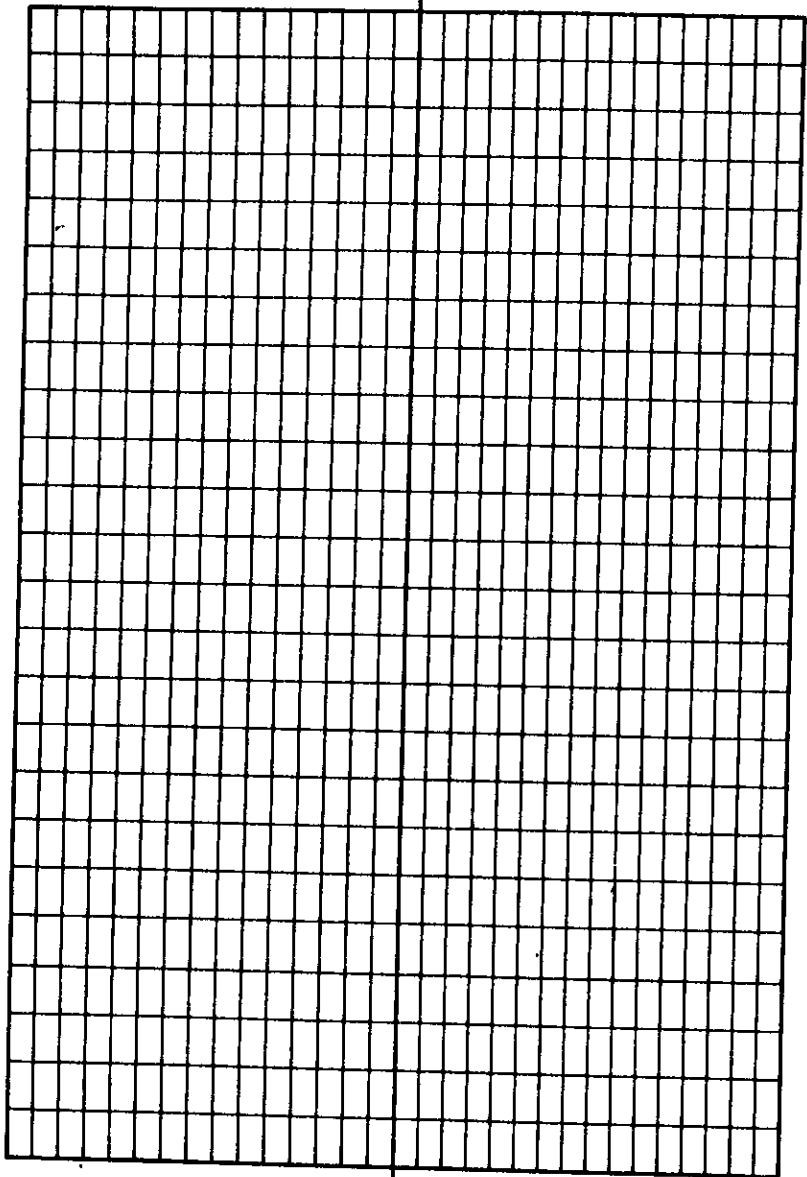
Packing up, getting ready for transfer to Lonely. J. Munter's "9am flight" got off at ~3pm. He took 6 coolers of water samples and some supplies. The remaining gear (+hazmat) went out with Martin Air about 5:30 directly to Pt Lonely. Our "12:00 Flight" went out at 8³⁰pm.

Stopped at Deadhorse to refuel & pick up last supplies at Martin Air. Arrive at Pt Lonely @ 10:30. Met Station Supervisor Landon Parker.

R. Spencer

46 342





46 343

8/28/88
8:00 breakfast Start planning day -
Went over maps - they seem better
than Bostons.

8:30 AM

8/24/88

Husky Landfill

- Upgradient sample HL-~~12~~ 9 & 10

1060-NS/50-12

Sample time: 1135

65-88-0001

end sampling: 1155

-0002

-0003 (water dips)

pH 6.98 "ER" on 9

T = 4°C

S = 0‰

C = 270 µmhos

8-1L 8 VOA 2 500 mL

1-7oz 2-16oz

Soil: Tan-brown organic silt - ML
HNU - BG

X¹ X² X³ X⁴ X⁵ X⁶ X⁷ X⁸ X⁹ X¹⁰ X¹¹ X¹² X¹³ X¹⁴ X¹⁵ X¹⁶ X¹⁷ X¹⁸ X¹⁹ X²⁰ X²¹ X²² X²³ X²⁴ X²⁵ X²⁶ X²⁷ X²⁸ X²⁹ X³⁰ X³¹ X³² X³³ X³⁴ X³⁵ X³⁶ X³⁷ X³⁸ X³⁹ X⁴⁰ X⁴¹ X⁴² X⁴³ X⁴⁴ X⁴⁵ X⁴⁶ X⁴⁷ X⁴⁸ X⁴⁹ X⁵⁰ X⁵¹ X⁵² X⁵³ X⁵⁴ X⁵⁵ X⁵⁶ X⁵⁷ X⁵⁸ X⁵⁹ X⁶⁰ X⁶¹ X⁶² X⁶³ X⁶⁴ X⁶⁵ X⁶⁶ X⁶⁷ X⁶⁸ X⁶⁹ X⁷⁰ X⁷¹ X⁷² X⁷³ X⁷⁴ X⁷⁵ X⁷⁶ X⁷⁷ X⁷⁸ X⁷⁹ X⁸⁰ X⁸¹ X⁸² X⁸³ X⁸⁴ X⁸⁵ X⁸⁶ X⁸⁷ X⁸⁸ X⁸⁹ X⁹⁰ X⁹¹ X⁹² X⁹³ X⁹⁴ X⁹⁵ X⁹⁶ X⁹⁷ X⁹⁸ X⁹⁹ X¹⁰⁰

4G 344

HL7-B, 1060-NS/50-011

12:25 - start 65-88-0001, 0002, 0003

Downgradient sample

pH 9.18 @ 25°C (w/ATC) 9.68 w/ATC "ER"

T 3.5°C

S 1‰

C 1300 µmhos

4-1L 1-500mL 4 VOA Jarster
1-16oz for dissolved metals
2-16oz, 1-7oz 3 soil

soil: Black organic silt
adiferous

HNU: BG

HL ⁷⁸ 9-10 5-6 1060-NS/50-010
12:55 start GS-BB-0001
13:10 end -0002

sediment & leachate sample -
southernmost location at landfill/
tidal flat

pH 9.57 water "E" 9.18 @ 25°C
T 5°C
S 1%
C 1400 μ mhos

Black organic silt - more liquid than
adiferous at -011

HNU- BG

Recalibration of pH meter @ 15:35
STD 1 pH 10 10.01 @ 25°C
STD 2 pH 4 4.00 @ 25°C

L. Spencer

46 345

HL 3/4 1060-NS/50-009
15:45 start BB-0001
16:05 end -0002
-0003 Df
mud

Middle of the 3' leachate sample

pH 7.31 @ 25°C
T = 4.5°C
S = 1%
C 1350 μ mhos

Soil: Dark grey
Black gravelly sand

HNU BG

L. Spencer

8/25/88 SNOWY, SUNNY
POL Storage Area

10:25 start 10:30 end
POW-1-PS6 1060-NS-023

2- 1L 418.1 water only
PH 7.95 @ 25°C
T 3°C
S 4.5 g
C 700 umhos

10:30 10:40 end
POW-1-PS1 1060-SO-016

1- 16oz 418.1 soil only

HNV = BG.

Dark brown organics & silt

J. Spence

46 347

8/25/88

10:55
POW-1-PS7 1060-SO-020

1- 16oz 418.1

Brown organics, some silt

11:05
POW-1-PS5 1060-SO-022

1- 16oz 418.1
Red-brown plastic silt

14:25
POW-1-SO-02 1060-SO-014
At beach tank pad - within
2- 16oz - 418.1 diked
area

brownish gray sand
HNV = B.G.

J. Spence

14:35

POW 1-50-03 1060-50-015
In open tundra NW of beach
Tanks, in line with "Gyng Tree"

2- 1602 418.1, 8080

Organics + grey silt

HNU - BG

14:50

POW 1-~~50~~²⁵-01.2 1040-50-025

2- 1602 8080, 418.1

1- 702 8240

organics and brown sand in 2
layers composited together
HNU - BG

This is the northernmost of 2
OL samples. No leachate observed
here.

L. J. J. J.

4G 348

~~15:30~~ 14:55

POW 1-01.1 1060-50-024

2- 1602 8080, 418.1

1- 702 8240

Brown gravelly medium sand
with some organics

15:30 16:30

Package samples and
gear for flight out tonight
Clean up work area

21:30 Cape Smyth is definitely

not coming in due to weather.
Will make 2 flights tomorrow.

L. J. J. J.

8/26/88

- 0845- Mapping sampling locations
 - Fuel Spill
 - POL Storage
 - Beach Tanks
 - Old Landfill

1200- Move our gear over to work area. Put on pallet

Flight info- Cape Smyth won't fly 207. Can charter the Navaho to Barrow. Two seats available on DEWLINE transport.

1600- Only one seat available on transport - I'll go with the 3 coolers & gear

1740- Arrive Deadhorse. Alaska Air ready to leave at 1745 - but delayed due to weather - I took coolers & 1 bag & the POW-2 people took the rest of the gear to Martin Air.

L. Spencer

46 349

~1930 - Arrive Anchorage airport
 - Called Joel Kushers ⁵³¹⁻³⁶⁵⁴ for Bullen Pt schedule to have C. Vans pick up decon water and ship gear.

- Called Marty at Martin Air 659-2544. All our gear was delivered to his shop by POW-2 people. He will take everything but decon water to Mark Air for tomorrow's 2pm flight to Anchorage. Will hold decon water for C. Vans.

- Called Prudhoe Bay Hotel. C. Vans & F. Wehrhans due in Wed. 8-31. Left message to pick up decon water at Martin Air & call Kelly S or Bill Pyle for more info.

- Called Joel back to inform him & have no problem.

- Called Marty to say C. Vans will be back in Deadhorse 8/31 & will stop by Wed or Thurs.

L. Spencer

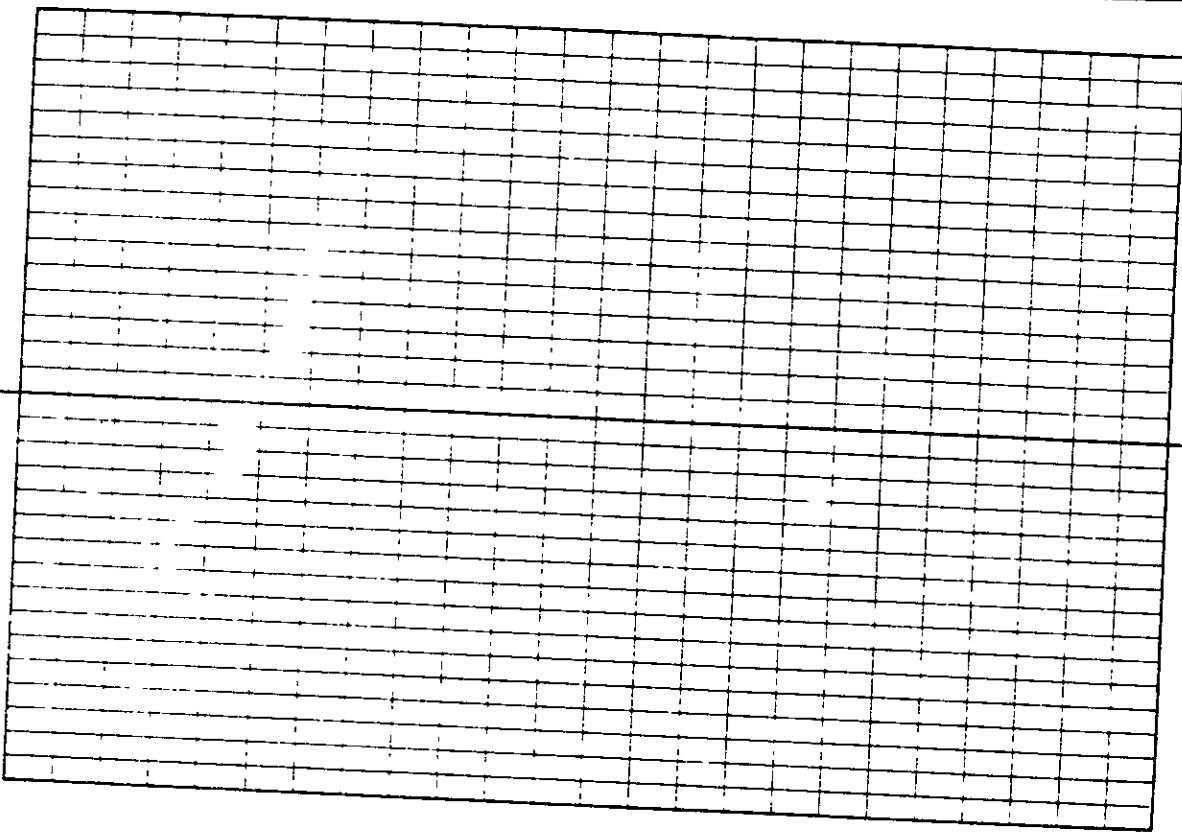
~2800

Not a Suberona & K. M. Kelly
at New York, New York
up plane de laque en (C
- 421161200

END

77 JECUVAAL

77 JECUVAAL



J. Munter
Field Notes
DEWLINE
Aug 1988

J. MUNTER



TRANSIT

NOTEBOOK NO. 301

90275J

Aug 1988

Book #1

S (APT)

Brk 7:30-8:15

Lunch 1300-1330

Dinner 18:30-19:15

Task #s

hydrology

Mobat

travels

camping
mapping

3301

3701

3301

M-4 @ 3701

Wkc

(T 11½)

W

J. Munter

Aug 16 TUES

11:00 AM Alaska Daylight Time
Through project (Deedline)

Lv Anch 8 AM flt to Deadhorse. Go to
Martin Air & Move gear from Mark Air to
Martin Air & Fly to Baker Island/Kaktovic
Arrive ~ 1 PM & get logged in and have
briefing on quarters & eat lunch

(Deadhorse) Martin Air. 6592599

Questions for Moll. North Star Anch.

1. Campers 1) Respirator / ins

2. Sewage facilities operation 2). maps.

3. maps.

4. Freeze ice - where - looked?

Cape Smyth flits study? from Deadhorse

Mark Sims

5. Messager service. 6. AL 9902 will AP

6. Vehicle call 111.9

7. Mayor's office

8. Escorts / security - rest. vehicles

9. Leaving stakes.

10. water - 165 gallons source & disposal. does not want

11. solid waste disposal stuff left here.

Jamie A. Munter

8-16 P.2

- Mapping -
1. Soil + water sample points
 2. extent of contamination
 3. other unusual features

Sewage lagoon - Harry Flint has records

Went to pick up 2nd load of gear @
~ 4 PM + came back and
took recon of areas of concern.
Went to dinner at 6:30.

James A. Munter

8-17-83 Wed

41°F

SE 1.3 knots

@ 8:25

Watch
JM = 30 sec
5 min

8:30 AM Arrive in time for 9:45

Be here @ 7:00-7:30 to pick up samples

Harry Flint - station mechanic

8:42 AM - start in B train

Review of water + sewage system

- Main water inflow is metered except
for backwash which is 25 gpm for
about 10 min + 7 gpm @ 10 min + 2 gpm for 3 min

Sewage usage is not metered

No records on truck volume of effluent. Except other
this water is dumped on ground week.

Each train has own metered water source (B, C + D agg)

Sewage - all sewage goes back to holding tanks

@ B train ~ 2700 gal. 320 ft³

~ 99% of water in is outfallled according to Harry

To sewage lagoon from 100 ft³ tank

at least several times / day. In winter

some scraping of material occurs at

Lagoon, resulting in pile of black stuff @ east end

Total sewage on legs is from total water
usage (100%) from B, C, + D trains

James A. Munter

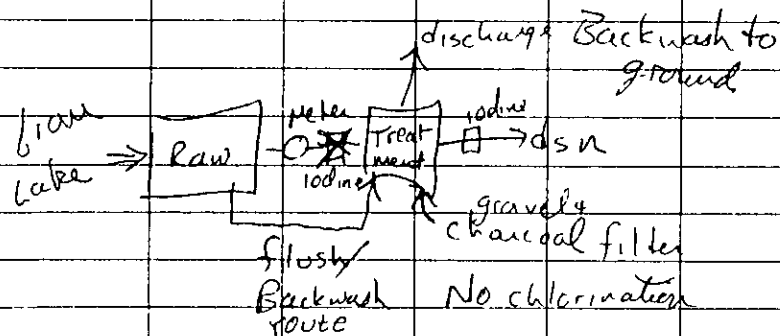
8/17 P.2

A+B have similar set of water systems

C Train

has raw water tank & meter. From tanker
Also has same backwash schedule as B train

D Train - not used - extra housing
has own source w/ filtered water + backwash
Backwash is not metered. Only Raw
water. D Train was used Aug. 87



(Colligan water filter @ D train)
No chlorine used anywhere (except sewage)
"Iodine crystals" (ECCI) used for treatment
(Emerald City Chemical, Seattle)

James A. Munter

8/17 P.3

A Train - office only gets treated
water from B train
- drinking fountain to 2 Johns

Monthly Wastewater Plant Reports

- on file - copied @ 9:42 AM by hand
in A Train - Paul's office

1987	Total wastewater use	
Jan	(2470 gpd * 31 days)	2470
Feb	74,800	2671
March	68,500	2210
April	70,600	2353
MAY	(from water reports) 65,300	
JUNE	(" " ") 88,900	
July	94,600	3052
August	130,200	4200
Sept	81,960	2732
Oct	71,500	2306
Nov	65,100	2170
Dec	69,300	2235

James A. Munter

8/11/88 PA
1988 Monthly Wastewater Plant Report

	Total Use	gpd
Jan	60,600	1,955
Feb	57,400	1,979
March (from water)	58,940	
April	59,400	1,980
May	65,700	2,119
June	71,600	2,386
July	71,700	2,319

Kalevick sewage input - copied from
notes of phone conv w' Loren Shale on
5/15/88

Sewage is 1) Heavy buckets sec-900/yr,
dumped into lagoon ~ 1 July until complete
(30-45 days, usually) They also

2) Heavy bulk sewage from 6 buildings
w' flush toilets Year-round
operation @ about 6,000 gal/week

(see more accurate info on copied reports)

Central office at NSB will maintain records for
grants & such

8/17 P.5

Have ^{sewage} records for about 2 months

Made photocopy for July data

Monthly variation is not much

But, smaller in summer because school is out.

Water usage is greater than sewage because
grey water is important

Loren Shale is leaving Sept 2nd or soonest
his replacement is not selected

10% of school water usage (washing machines)
goes on ground. - see July water report (copied)

"City" water goes to all bldgs except ^{water truck from storage reservoir}
school which is pumped directly

See printout for 1987 data (Manual
records of water usage are available)

Mark Sims Cape Smyth Air

Phone - pilot w' 707 & Roadhouse

38 1/2 ft x 15 1/2 ft

852 833.5

640-6013

6411-6615

James A
Munter

8/18 Overcast 3:00 After 4 birds
5:00 5:10
0815 Calibrated HNU 5
169414
500320
Both have 1620V both
Calibrated w/ E306 type
w/ again den zero calibration
OK 70 m/s
Both vents calibrated w/ both gauges
169414 span pot = 7.42
500320 span pot = 6.84
0915 Cell Temp 21mm water again
C9AD Proceed to elev area catch 15 and 17
Scrub side of building North of B. tran
(Kitching entrance) and south
802 trunk 15 (5) most 1/6 (1) than
Mammal
Decon standards the (spores visible) (with hand lens)
Desman, Alcorax, top water (potable
steal from
Fertile water rinse
Kotzebue (a)
Dis filter
rinse
rinse
rinse
He xane
rinse

8/17/64 492087 494676 494710 (1100) - Robin
76712277941.0 - Robin
Ate lunch
PM -
set series of sampling locations
discussed possibilities for handling
New addition & need to arrange to
see 'Martin' for 1st & 2nd stage

8/18 We will do only sediment samples today.

P2 We do not have field data, but, so all data will be in this notebook.

by decem area 10.15 go to Sewage lagoon

Location	Depth	Sample No.	Container
54R-M-SL3	Shallow	1042-SO-001	2-16 oz glass
		GS-SS-0001	1-703 glass

Throughout day

{ We are putting 8290 test in 703 jar.
" " " 8086 test in 1603 jar.
" " " 418.1, 6010, + D22216 in 1603 jar

HNU = Background = 0.2 ppm (on sample)

Slight septic or sewage odor

10:28 complete sampling

Landfill to west is burning & sending plume slightly south of sampling location

discard gloves

James A. Munter

Samplers Kelley & Keith

photo & pack samples - Robin

Sample description

Time of sample

black sandy gravel, GP
saturated, at water line

10:25 AM

Photo log:

2 photos at decem area, (7, 8)
3 at SL3 (9, 10, 11)

Sample taken near culvert in depression where seepage from sewage lagoon is emanating from sand bank

Each sample is being placed in individual zip bags

No breakage samples taken

James A. Munter

8/18 P.S.

Stream bed gravels showed orange rusty staining, at in main channel. Depart site 1109			
Active 1115 @ CD1			
Health & safety officer decided to sample w/d			
HNV water because it is upgradient, out of			
of HNV, w/ moderate wind. No detectable odors			
Location	Depth	Sample No.	TESTS
Time			
1120	Shallow	1042-50-030	8240
	sub. slightly		1120
	sediment		
		GS-88-0001	8080
			sediment, saturated
		418.1	
		6010	
		12216	
Sample taken in			
Stream bed w/ slow current, 0.1 ft depth			
about 100 ft upstream from riverbed under road			
about 100 ft downstream from main line w/ increased			
pole near stream center			
Completed sampling at 1132			
Depart @ 1135 & go to deck			
Took photo #16			
Recon spoons, shovel & pot extra HNV			

James & Munk

James & Munk

Arrive @ 1040 @ lower confluence of river			
Location	DEPTH	SAMPLE NO.	TESTS
Sample			
		1042-50-022	8240
		sed. pkgs	1045
		GS-88-0001	8080
			med sand
		418.1	
		6010	
HNV = Bg (= Background) (no sample)			
(response check OK)			
Sampling completed @ 1047			
(No bridgeage samples)			
2 photos taken (1213 from glen)			
Sample to test at edge of stream about even with			
bluff line			
Depart 1052			
We are sampling in an upstream direction to			
avoid disturbing sediment and influencing samples			
see table headings above			
Arrive	CD	No.	TESTS
		1042-50-022	8240
		sed. pkgs	1100
		GS-88-0001	8080
			sand, med,
		418.1	
		6010	
Sampling done at 1105			
Samples taken 20 upstream of confluence w/			
main channel in west tributary from sewage lagoon area			
later with dry hole for future H2O sample			
Bulb not			
HNV = L. Hanning 1056			
Photos 19415			
No bridgeage samples			

8/18 P6

using 500320 HNU ↓

James A. Munter

Arrive NL4 @ 1213 see page on N side of Near Landerin

LOCATION	Depth	Sample No	Description	TESTS	TIME
BAR-M-NL4	shallow	1042-SO-012	OL, black,	8240	1220
		GS-88-0001	organic material	8080	

w/ some gravel, 418.1

Green algae common near sampling point. Water saturated w/ 02216

(leachate visibly emanating black liquid w/ slight from gravel embankment 3 ft away. Obvious contamination

HNU reading on sample - peak of 20 ppm, avg = 7 ppm

(w) 1222 Sampling done at 1222

Took 2 photos (17 & 18)

depart site @ 1225

Arrive NL3 @ 1226

Location	Depth	Sample No	Description	Tests	Time
BAR-M-NL3	shallow	1042-SO-012	Description	8240	1230
		GS-88-0001	sw Orange & black	80, 80	

fine-grained sand w/ 418.1

Sample taken in bed of stream emerging from area east of new landfill 4' upstream from confluence of stream running North South. Sample taken 6' upstream from culvert.

HNU = Bg on sample. Sample completed @ 1232

Took 1 photo (19)

8/18 P7

Arrive NL2 1239

LOCATION	Depth	Sample No	Description	TESTS	TIME
BAR-M-NL2	shallow	1042-SO-009	SP, dk brn,	8240	1245
		GS-88-0001	sand, fine-gr,	8080	
			w/ gravel & organic	418.1	
			(grass, roots),	6010	
			Saturated	02216	

Sampled in old tire rut (years old) w/ water puddled in. Located 12' N of road in grassy, mostly ^{moist} soft & firm ground. Dig out larger hole for water sample

HNU = Bg @ 1249 Took 1 photo (20)

Done sampling @ 1248 left site 1252

Arrive NL2 1255

LOCATION	Depth	Sample No	Description	Tests	Time
BAR-M-NL2	shallow	1042-SO-010	SP, Brn	8240	1300
		GS-88-0001	SS sand, w/	8080	
			gravel, sat.	418.1	
				6010	

Sample taken from N side of pond w/ 02216

No current in shallow water at edge of marshy grasses ~1 ft tall

Took 2 photos (21 & 22)

HNU = Bg @ 1301 left site @ 1303

GC TO LINDER

James A. Munter

46 359

8/18 P8

James A. Munter

arrive OL5 @ 1516 - downstream of old landfill

Location	Depth	Sample No.	Description	Tests	Time
BAR-M-OL5	shallow	1042-SO-007	sw. ^{gravel} _{partly}	8290	1525
		GS-88-0001	sorted sand, w/	8080	

gravel, saturated 418.1

sampled from bed orange coating on 6010

of stream downstream surface of gravel D2216

from emergence from gully and ~ 50 ft up from sea

HNU = Background in steel bowl @ 1525

Also took field duplicate as above except:

Sample No.	Tests
1042-SO-007	8290
GS-88-0003	8080

418.1

stream runs through area 6010

of old drums eroding out of bank in gully just south of sample location.

took video film & 1 photo (23)

Finish & leave @ 1535

Arrive OL4 @ 1538

located at top of bluff where stream cascades over

James A. Munter

8/18 P9
13

Location	Depth	Sample No.	Description	TEST	TIME
BAR-M-OL4	shallow	1042-SO-006	SM, under	8290	1540
		865-88-0001	silly ^{fine} sand, 8080		
			saturated	418.1	

collected 3 ft up from water fall

6010

at bluff, in channel of stream

D2216

that drains old landfill leachate and

stream from sewage lagoon area.

HNU = Bg @ 1545 (on sample)

Response check on HNU. Showed OK

Took 1 Photo (24)

Took video here earlier on way to OL5

Leave site @ 1548

Took photo indicating (1") roll of film (25)

Dig pit at OL3 for subsequent water sample

and record item video

Arrive OL2 @ 1600

Location	Depth	Sample No.	Description	TEST	TIME
BAR-M-OL2	shallow	1042-SO-005	OL, OL, OL	8290	1600
		GS-88-0001	Organic, w/	8080	

sampled from edge of standing vegetative det.

418.1

water in swale 30' east of saturated 6010

gravel-covered landfill ~ 150 D2216

down gradient of sewage lagoon

Took 1 photo (26)

P10
18

Some floating plastic debris near sample location
 Finish sampling @ 1611
 HNU reading = Bg on sample

James A. Munter

ARRIVE GL3 @ 1622 HRS.

LOCATED @ EDGE OF STREAM
 10 FT DOWN STREAM FROM
 CONfluence of STREAM along western
 edge of OLD land fill AND small
 east-west drainage.

BAR-M-GL1, shallow 1042-50-004
 GS-88-0001
 -0001 ms/msp

SAMPLE WAS BROWN SANDY GRAVEL.
 SATURATED. GP.

TOOK ONE photo (27)

HNU = B.G. @ SAMPLE

SAMPLE TIME 1625

8240, 418.1, 6010, 2216, 8080

THESE NOTES BY KELLY JOSEWIND

8/18/88

"visible contamination" not very obvious at ⁰¹¹⁵ two sites. we selected most likely contaminated spots

ARRIVE PB-1 @ 1658 Sampled @ 1700

Location	depth	Sample No.	desc.	TEST
BAR-M-PB1	shallow	1042-50-013	SW, grey	418.1
		GS-88-0001	med. ss sand	D2216
			saturated	

HNU = Bg @ 1700

Sampled water-filled E-W trench (old fire track)
 3/2 east of road/berm on east side of POL catch
 basin.

TOOK photo #28

Also took duplicate as above except:

SAMPLE NO: 1042-50-013 + TEST: 418.1
 GS-88-0002

Leave site @ 1706

ARRIVE PB2 @ 1707 Sample Time = 1710

Location	depth	Sample No.	Description	TEST
BAR-M-PB2	shallow	1042-50-014	OL, DK Brn	418.1
		GS-88-0001	w/leafy veg	D2216

HNU = Bg @ 1713 saturated

TOOK photo #29 Took sample from area w "some
 orange dead grass 15' from road, standing water
 @ land surface. LV site 1715

James A. Munter

3/18 P13

Arrive PB6 @ 1732
 LOCATION depth Sample No. description tests
 BR-M-PB6 shallow 1042-50-018 5g Brn 418.1
 GS-88-0001 fine sand, 02216
 HNU = Bg
 Take Photo # 32
 Took sample in firm ground in grassy area.
 Left site @ 1738
 Arrive PB4 @ 1740
 LOCATION depth Sample No. description tests
 BR-M-PB4 shallow 1042-50-116 01 green 418.1
 GS-88-0001 brown, mossy 02216
 Had to dig through turf to get turbid water.
 Sample, standing water in grass.
 Photo # 33
 HNU = Bg @ 1745 HNU check = O.K.
 Sample Time = 1748
 Arrive PB7 @ 1747
 LOCATION depth Sample No. description tests
 BR-M-PB7 1042-50-019 5g grey 418.1
 GS-88-0001 w/ abundant 02216
 Located in wet purple grass saturated
 soggy ground
 Left site @ 1752 HNU = Bg Photo # 34

8/18 P12
 J. M. M. M.

Arrive PB5 @ 1717 Took Photo # 30
 LOCATION depth Sample No. desc. TEST TIME
 BR-M-PB5 shallow 1042-50-017 5g Brn 418.1 1717
 GS-88-0001 partially 02216
 HNU = Bg @ 1718
 Took Photo # 30.
 Took sample from firm ground, approx. 1718
 not visible, contaminated
 in grassy area
 Left site @ 1523
 Arrive PB3 @ 1524
 LOCATION depth Sample No. desc. TEST TIME
 BR-M-PB3 shallow 1042-50-015 5g grey 418.1 1727
 GS-88-0001 w/ abundant 02216
 organics and
 some gravel, saturated
 HNU = Bg
 Took sample from soggy area w/ short (6") grass
 No visible contamination
 deposit site @ 1732
 M. M. M.

8/19

Friday

8:30

35° wind W @ 12 knots
overcast & misting wind 1.1.11-18°

Arrive old land fill 9:45 P. cloudy, 40°

wind from ENE @ 1.5 knots

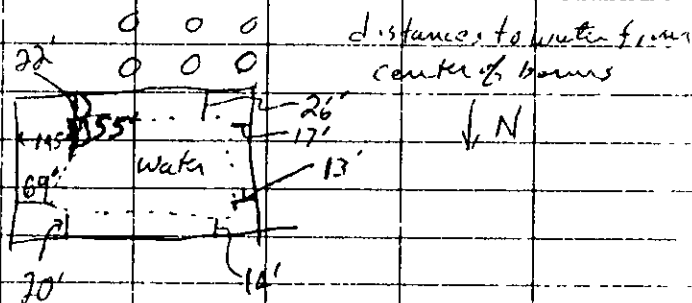
Start mapping location of sampling

Major topo features near old land fill

Go to Airport & deliver samples @

10:15. Back to map sewage lagoon @

See Field Map 1 for outline of SL



EW distance between POL tanks = 822.5'

⇒ scale = 1" = 200'

NS distance between POL tanks = 79' ⇒

scale = 1" = 190'

⇒ use average scale of 1" = 195' instead
of 1" = 173'

1300 Eat lunch

James O. Minter

8/19 P.2

Started mapping sample locations @ 1400,
after discovering that base maps seemed
quite inaccurate, and concluding that
we would have to start a new
map using POL tanks as starting
point.

1430 Went to Airport to pick up supplies
brought in by Martin Air.

1500-1800 - Continue mapping sampling
locations, using Field Maps #1, #2 &
#3

1800-1930 - dinner

1930-2300 - Drawing up maps and
filling out Air Monitoring Data sheet
for 8/18 and planning tomorrow's
work

James O. Minter

8/20 P cloudy 34° Wind W @ 12 kts

Field from Jm & KM

James O. Monte

New Landfill area. No rain since at least

8/16, Base flow conditions

H1 - discharge at culvert near N41

see Field Hydro Map 1

H2 Q in dug ditch vel - $1 \frac{1}{4} \frac{ft}{sec}$

0915

w - $0.2 \frac{ft}{ft}$

$Q = 0.0023 cfs$ depth - $0.15 \frac{ft}{ft}$

H3 0927

$\frac{1 \frac{1}{4}}{4 sec} \times 0.20 \frac{ft}{ft} \times 0.03 \frac{ft}{ft}$

= $0.0015 cfs$

H4 0947

$\frac{1 \frac{1}{4}}{12 sec} \times 0.30 \frac{ft}{ft} \times 0.03 \frac{ft}{ft}$

H5 $\frac{1 \frac{1}{4}}{9 sec} \times 0.30 \frac{ft}{ft} \times 0.03 \frac{ft}{ft} = 0.0010$

0956

H6 1000 $\frac{0.7 \frac{ft}{ft}}{1 sec} \times 0.15 \frac{ft}{ft} \times 0.03 \frac{ft}{ft} = 0.0021$

Upstream of confluence of culvert
in east park

H7 $\frac{1.8 \frac{ft}{ft}}{6.6 sec} \times 0.40 \frac{ft}{ft} \times 0.03 \frac{ft}{ft} = 0.00327$

1003 @ entrance to culvert

7/20 P2

Move to west side of NL

H8 $\frac{1.8 \frac{ft}{ft}}{6.6 sec} \times 0.50 \frac{ft}{ft} \times 0.06 \frac{ft}{ft}$

@ 1040

Most water at H8 seems to originate
from trench, not landfill

H9

1102 $\frac{0.6 \frac{ft}{ft}}{10 sec} \times 0.25 \frac{ft}{ft} \times 0.2 \frac{ft}{ft}$

H10 1115 $\frac{2 \frac{ft}{ft}}{6.5 sec} \times 0.5 \frac{ft}{ft} \times 0.08 \frac{ft}{ft}$

H11 1120 $\frac{2 \frac{ft}{ft}}{35 sec} \times 0.5 \frac{ft}{ft} \times 0.05 \frac{ft}{ft}$

Position of confluence of stream N
of N landfill & stream W of O.B. landfill
in tributary (E/W flow)

H12 $\frac{1.5 \frac{ft}{ft}}{11 sec} \times 0.4 \frac{ft}{ft} \times 0.06 \frac{ft}{ft}$

1129 13' downstream of H11

H13 $\frac{2 \frac{ft}{ft}}{2.5 sec} \times 0.6 \frac{ft}{ft} \times 0.09 \frac{ft}{ft}$

1135 G. downstream of D41

8/20

H14 2.3' / 3 sec $\times 0.35 \times 0.11$
 1138 4' upstream of DLS Turbulent Flow
 Plotted on field hydro map 2

H15 14' / 2 sec $\times 0.5 \times 0.02 \times 0.015'$
 1203 25' upstream of culvert west of Newland Fill

Photo 20 Moblog Camera Squeeze Flow under
 culvert out of Sewage Lagoon

H16 Near SL3
 1218 1 ft / 4 sec $\times 0.2 \times 0.03$
 7' upstream of culvert under Honey Buckle Rd
 South

H17
 122 2' upstream of culvert under Honey Buckle Rd
 east
 1 ft / 2 sec $\times 0.2 \times 0.02$

H18 in culvert @ upper end
 1 ft / sec $\times 0.3 \times 0.02$

H19 115 upstream S of SL3 culvert under Honey
 1 ft / 3 sec $\times 0.15 \times 0.01$ Buckle Rd

LUNCH - Plotting on Field Hydro map #4

1450 @ downstream of double culvert below CD 1

H20 3 ft / 1.3 sec $\times 0.6 \text{ ft} \times 0.06 \text{ ft}$
 - Main culvert - trivial flow (footing) in 2nd
 Culvert has flow culvert

from 3 channels Relative

% app of flow is (from east to west: 50:35:15)
 Site CD 1 is in 50% tributary

H21 3 ft / 1.3 sec $\times 0.8 \times 0.15$
 1510 20 ft below 5 drains in
 channel

H22 1 ft / 3 sec $\times 0.15 \text{ ft} \times 0.02 \text{ ft}$
 1513

H23 0.2 ft / 1.8 sec $\times 0.22 \text{ ft} \times 0.03 \text{ ft}$
 1518

H24 2 ft / 2.5 sec $\times 0.5 \text{ ft} \times 0.15$

1525 - upstream in CD main from
 confluence w/ trib from SL

H 25 $\frac{4 \text{ ft}}{4 \text{ sec}} \times 1 \text{ ft} = 0.00 \text{ ft}$
1535

H 26 50' up from CD
1537 $\frac{4 \text{ ft}}{4 \text{ sec}} \times 1 \text{ ft} = 0.15 \text{ ft}$

H 27 $\frac{4 \text{ ft}}{4.7 \text{ sec}} \times 1 \text{ ft} = 0.16 \text{ ft}$

1540

Trib from sewage lagoon appears to have a terrace 4-5 ft above active channel w/ active erosion. This may indicate higher flows now than during recent geologic time. Trib valley on west side of valley of CD is not documented similarly.

Fundra outside SL berm has possible contamination outside NE corner of berm. This area is wet continuously to trib to CD to the east.

1602 Gully G1 has seepage of water with very active erosion & failing gully walls. Seepage has organic film on it and may be SL effluent.

1608 Gully G2 has slight seepage.
(see Field Hydrology #5)

1620 flow of d.t.h. draining area N of SL past OL2 into OL channel
H 28

Very poor place for flow estimate, but best there is.

vel = $\sim \frac{1 \text{ ft}}{8 \text{ sec}} \times 0.15 \times 0.08$

H 29 Flow $\frac{2 \text{ ft}}{7 \text{ sec}} \times 0.10 \times 0.01$

② seepage out of OL 5 ft below OL3
③ 1630

More seepage occurs to the east, about 20% of main seepage

H 30 $\frac{2.5 \text{ ft}}{3 \text{ sec}} \times 0.25 \text{ ft} \times 0.02 \text{ ft}$

1700-1800 - Run gradients sludge - black organic sludge (damp) formerly saturated. Maybe source of leachate through berm

8/21/82

Arrive 022 1034
COLATION
TESTS
5 Sample No
1042-NS-021
GN-88-0002
SAMPLE
TIME 1040
yesterday
4811
6010 (Hd)
6010 (d.f)
9132
PH TEMP - Salinity Conductivity @ 1036
7.81 3.8% 0.2% 540
Photos 16417
Using Robins camera, roll #2
② 1100
Took dupl. each sample
TESTS
8080
418.1
9132
GN-88-0003

8/27 Sunday
3:30 1st rain
- water sampling.
4:40 AFE Skye
Gear up + load out @ 0930

Index of confidence & examples

TEST	CONTRACTS
------	-----------

10	1000 (11)	8010
----	-----------	------

8220	VPR(11)
------	---------

0508 (E) 11/08/1

25 m 400 (15) 0100 (1004)

510 ml poly (9D) 6010 (diluted)

1 1/2 oz softie poly 9132

29/01/11 18/1

1988/00010992 YSI

PH TEM (C) Solubility

716	5.0	0%	358	(100000)
-----	-----	----	-----	----------

Test	Sample No	Time
------	-----------	------

0950 1042-NS-020

2000-88-NP

0308

collected from	418.1
----------------	-------

6010 (7407) 0109 0201 02

1507 1 0709 0109 (P) 150519 (P) 1117 1707 1507

Photo - Take one \$15

Location	TESTS	Sample No.
BK-M-NL3	8010	1092-N5-011
	8020	GN-88-0002
	8080	
	48.1	Sample Time = 13.57
	6010 (tot)	15
	6010 (dis)	
	6010 (dis) 6.2	conductivity
	7.92	0.7%
	6.2	395 photos
		END SHOOTING @ 1330
		Took photos 21, 22 & 23
LOCATION	TESTS	SAMPLE NO.
BK-M-NL4	8010	1092-N5-012
	8020	GN-88-0002
	8080	
	918.1	DURS 1042-N5-012
	Field duplicate	6010 (tot)
	in same fats	6010 (dis)
	+ time	"water" here is
		Dr Gray - black
		PH, TEMP, Salinity, Conductivity
	7.92 6.5%	3810 photos
	3.5	Finish sampling 1941
		Took photos 24 & 25

Location	TESTS	Sample No.
BK-M-C03	8010	1092-N5-022
	8020	GN-88-0002
	8080	
	918.1	Sample Time
	6010 (tot)	11.43
	6010 (dis)	Finish sampling 1155
	9132	
		PH, TEMP, Salinity, Conductivity
	7.91 4.9%	520 photos
	0.3%	Took Photos: # 18, 19
Arrive C03 @ 1136		
8/21 P3		

Arrive NL3 @ 1310
 While first floating on trib. from south that we
 are not sampling. Source is in vicinity of sewage
 line @ main groove (red ~ 500 ft south
 sample point 3' upstream from confluence
 in west tributary. slightly noticeable
 odor. Light + steady rain all day.

8/21 P.5

@ 3.15

went to dinner + returned to DCM shop
+ filtered samples until 9:45 PM

Stacey Brown
Staff Chemist

Woodward-Clyde Consultants

Consulting Engineers, Geologists and Environmental Scientists

500 12th Street, Suite 100
Oakland, CA 94607-4014
(415) 893 3600



Bullen Point AFS
~~Attest~~ 10 Sept. 1988

"Rite in the Rain"
The paper in this book has been treated by an exclusive chemical waterproofing process. Wet or dry, even the hardest pencil will produce a clean, sharp mark.

KEUFFEL & ESSER CO.

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

roadway of any width. Side Slopes 1½ to 1.

In the figures below, opposite 7 under "Cut or Fill" and under 3 read 11.0, the distance out from the side stake at left. Also, opposite 11 under "Cut or Fill", and under 3 read 16.7, the distance out from the side stake at right.



Cut or Fill	Distance out from Side or Shoulder Stake										Cut or Fill
	0	1	2	3	4	5	6	7	8	9	
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	4
5	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	5
6	9.0	9.2	9.3	9.5	9.6	9.8	9.9	10.1	10.2	10.4	6
7	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	7
8	12.0	12.2	12.3	12.5	12.6	12.8	12.9	13.1	13.2	13.4	8
9	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.6	14.7	14.9	9
10	15.0	15.2	15.3	15.5	15.6	15.8	15.9	16.1	16.2	16.4	10
11	16.5	16.7	16.8	17.0	17.1	17.3	17.4	17.6	17.7	17.9	11
12	18.0	18.2	18.3	18.5	18.6	18.8	18.9	19.1	19.2	19.4	12
13	19.5	19.7	19.8	20.0	20.1	20.3	20.4	20.6	20.7	20.9	13
14	21.0	21.2	21.3	21.5	21.6	21.8	21.9	22.1	22.2	22.4	14
15	22.5	22.7	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.9	15
16	24.0	24.2	24.3	24.5	24.6	24.8	24.9	25.1	25.2	25.4	16
17	25.5	25.7	25.8	26.0	26.1	26.3	26.4	26.6	26.7	26.9	17
18	27.0	27.2	27.3	27.5	27.6	27.8	27.9	28.1	28.2	28.4	18
19	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	29.9	19
20	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.4	20
21	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.6	32.7	32.9	21
22	33.0	33.2	33.3	33.5	33.6	33.8	33.9	34.1	34.2	34.4	22
23	34.5	34.7	34.8	35.0	35.1	35.3	35.4	35.6	35.7	35.9	23
24	36.0	36.2	36.3	36.5	36.6	36.8	36.9	37.1	37.2	37.4	24
25	37.5	37.7	37.8	38.0	38.1	38.3	38.4	38.6	38.7	38.9	25
26	39.0	39.2	39.3	39.5	39.6	39.8	39.9	40.1	40.2	40.4	26
27	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6	41.7	41.9	27
28	42.0	42.2	42.3	42.5	42.6	42.8	42.9	43.1	43.2	43.4	28
29	43.5	43.7	43.8	44.0	44.1	44.3	44.4	44.6	44.7	44.9	29
30	45.0	45.2	45.3	45.5	45.6	45.8	45.9	46.1	46.2	46.4	30
31	46.5	46.7	46.8	47.0	47.1	47.3	47.4	47.6	47.7	47.9	31
32	48.0	48.2	48.3	48.5	48.6	48.8	48.9	49.1	49.2	49.4	32
33	49.5	49.7	49.8	50.0	50.1	50.3	50.4	50.6	50.7	50.9	33
34	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.2	52.4	34
35	52.5	52.7	52.8	53.0	53.1	53.3	53.4	53.6	53.7	53.9	35
36	54.0	54.2	54.3	54.5	54.6	54.8	54.9	55.1	55.2	55.4	36
37	55.5	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	37
38	57.0	57.2	57.3	57.5	57.6	57.8	57.9	58.1	58.2	58.4	38
39	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.6	59.7	59.9	39
40	60.0	60.2	60.3	60.5	60.6	60.8	60.9	61.1	61.2	61.4	40

Sept. 11, 1988

9am - Arrive a barge. Load
truck onto to Amer supplies.

9:30 - ~~At~~ Leave Denchorse
for Buller Point.

11:00am - Beached barge at
Buller point. Unloaded
supplies.

11:45 - Inspected Shed No. 2.
Dunbar frozen will hope
sun will melt surface.

Inspected Shed No. 1 with
Chris. Very strong fuel
smell.

1:30 - Toured site with Fred & Chris.
Encountered transformer,
Drum of oil, batteries.

1:30 - Meeting to establish work plan.

62

Box Number

Sept. 12, 1988

0815 - Begin setup. Start to remove head on inside transformer. (Chas & Fred)

0845 - Begin calibration of PCB field test kit.

Rinse sol reads 142 before cal.

Cero sol reads 000

Spe Sol. reads 96 gdy to 100

Rinse sol reads 153 after calib

Prepared (4) reaction vials for sample testing

0910 - Can't remove head on inside transformer, will tube bolts and start on Shed No. 1 removed (paint and gels)

(3)

- 0930 - Chris found 5-10 1-gal cans of ~~transforming~~ oil in Shed No. 1. We decided to test for PCBs in oil.
- 1000 - 1-gal can of oil tested 3 times with ~~WLS~~ but all test color at initial step. Contents > 500ppm of PCB.
- Continued with step 2 sample turned white solid on top layer.
- pipet reads 1769 mU.
- 1030 - 5-gal can oil from Shed No. 1 tested for PCB.
- sample color turns brown ~~100~~ level ~~500ppm~~.
- tested sample using the

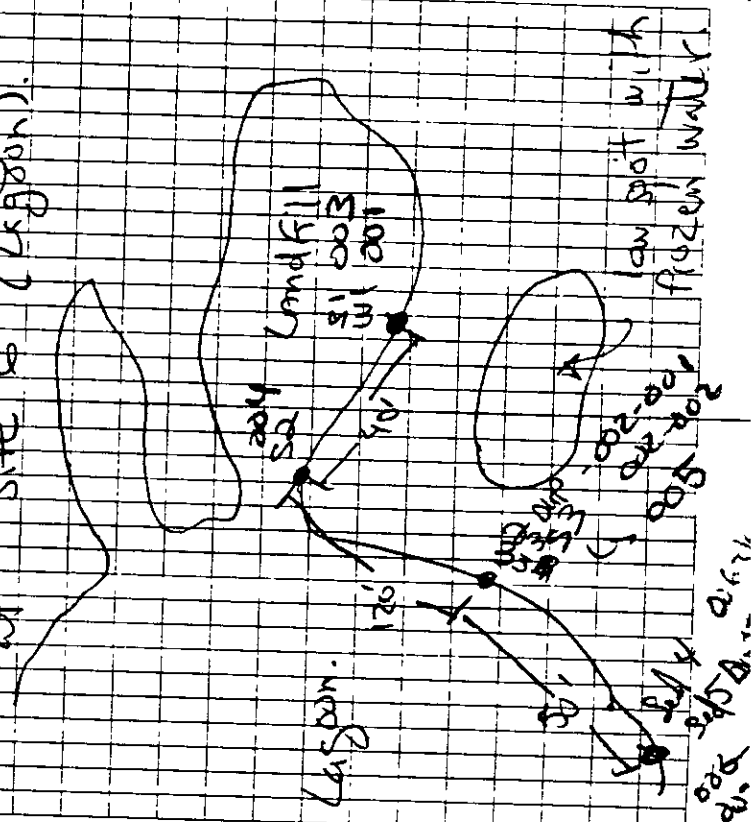
(4)

How fast KLT Chlora - N- and KLT

sample ~~turned~~ was lower than
old, so not pure PLB

sample turned purple, so
conc. < 5 ppm by color
chart.

1130 - setup for taking samples
at site 6 (Lagoon).



(5)

1300 Setup ice chest for lagoon sampling.

- Calibrated pH, Sp Cd meters.

- pH calib. std 10.7
check (7) reads 6.95
@ 25°C

- Sp Cd - red line is under one notch with noble maxi out.

Will let equilibrate

1345 W. side temp 3°C
Cloudy, clear
no wind.

Surface water sample

001 - 0001

Temp = 3°C
Sp Cd = 13000
pH = 8.0

(6)

	Sed	001	name	location
1355			no water 001	
1405	Sed	002		
1420	water	003		
	Temp.	=	2.3°C	
	Sp. Cal.	=	13500	
	9 H	=	7.7	
1435	water	003		Dup
	Sed	003		
	Sed	004		Dup
	Sed	005		Dup
1445	Amb-Cnd	Blend		
	Snow	Flurries		
1455	Sed	004		
		005		Dup
1510	Setup	filter appar.	for	
	dissolved	samples		
1535	Start	filtering	samples	

1610 - Chris informed me that
Shed No. 2 contained
lube oil (found 5-gal
can of lube oil) spilled
inside. Don't need to
take water samples.

Site 3

Transformer was as
Alice Chalmers 3 KVA nitrogen
filled transformer. No
sample was taken for
this reason.

Site 4

Transformer oil tested
for PCB (MGBE)
test results negative
white precipitate formed.
Chlor No. test
results purple color < 5 ppm
PCB.

— under building Chris
informed me that no stain
on ground, no leaking thing

(8)

1706	Soil Sample 001 E
1715	002 taken from site
	4 under building.
	007, 008 - SS - 211
1730	- 011 sample taken from transformer.
	Sample 003
	209 - 88 - 008

TAB

Appendix D

APPENDIX D
UNIFORM HAZARDOUS WASTE MANIFEST
AND
DD 1348-1 FORMS
AND
CHAIN-OF-CUSTODY FORMS

Please print or type (Form designed for use on 12-pitch typewriter)

Form Approved OMB No 2050-0039 Expires 9-30-88

UNIFORM HAZARDOUS WASTE MANIFEST		1 Generator's US EPA ID No	Manifest Document No		2 Page 1 of 1	Information in the shaded areas is not required by Federal law	
3 Generator's Name and Mailing Address		AK257002B652		00188		A State Manifest Document Number	
US AIR FORCE - BULLEN PT. DEW LINE BULLEN PT. ALASKA						B State Generator's ID	
4 Generator's Phone (907) 552-4151						C State Transporter's ID	
5 Transporter 1 Company Name		6 US EPA ID Number		AKD 980975916		D Transporter's Phone	
7 Transporter 2 Company Name		8 US EPA ID Number				E State Transporter's ID	
9 Designated Facility Name and Site Address		10 US EPA ID Number				F Transporter's Phone	
52362D. DRMO ANCHORAGE BLDG 22-009 ELMENDORF AFB, AK 99506		AKB57002B649				G State Facility's ID	
11 US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)		12 Containers		13 Total Quantity		14 Unit Wt/Vol	
HAZARDOUS WASTE, SOLID N.O.S., NA9189, ORM-E		4 DM		1100		P	
WASTE, PAINT RELATED MATERIAL, NA1263, FLAMMABLE LIQUID		1 DM		35		G	
WASTE, COMBUSTIBLE LIQUID N.O.S., NA1993, COMBUSTIBLE LIQUID		1 DM		25		G	
WASTE, POLYCHLORINATED BIPHENYLS (>500ppm) RQ-10(4.54), UN2315, ORM-E		6 DM		800		P	
J Additional Descriptions for Materials Listed Above		K Handling Codes for Wastes Listed Above					
a.) SOLIDIFIED OILY WATER, CRUSHED CANS b.) PAINT THINNER c.) LUBE OIL, PETROLEUM OIL d.) TRANSFORMER, TRANSFORMER OIL, PCB CONTAMINATED SOLID MATERIAL							
15 Special Handling Instructions and Additional Information							
POLYCHLORINATED BIPHENYLS (PCBs) ARE OF HIGH CONCENTRATION - HANDLE WITH APPROPRIATE CARE.							
16 GENERATOR'S CERTIFICATION I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled and are in all respects in proper condition for transport by highway, according to applicable international and national government regulations.							
If I am a large quantity generator I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage or disposal currently available to me which minimizes the present and future threat to human health and the environment. OR if I am a small quantity generator I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.							
Printed/Typed Name		Signature		Month Day Year			
FREDERICK WEHRENBURG, WOODWARD CYCLE FOR USAF				19 14 88			
17 Transporter 1 Acknowledgement of Receipt of Materials		Signature		Month Day Year			
LANCE R. BREWSTER				19 18 88			
18 Transporter 2 Acknowledgement of Receipt of Materials		Signature		Month Day Year			
19 Discrepancy Indication Space							
20 Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in item 19		Signature		Month Day Year			
SAMUEL P. SWARRIGEN				09 12 88			

All signed by
Bill Pyle
10-3-88 + accepted
by DRMO-Elmer Dorf

JD FORM 1348-1
(4 PART)

1 MAR 74

DOD SINGLE LINE ITEM RELEASE/RECEIPT DOCUMENT

DOC IDENT		RI FROM	MI	STOCK NUMBER		ADD	UNIT	ISSU	QUANTITY	DOCUMENT NUMBER		SUPPLEMENTARY ADDRESS		FUNCTION		DISTRI	PROJ	ECT	PRI	ORIT	REC D	DEL	DATE	ADVISE	RI	UNIT PRICE																							
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BULLEN PT DEW LINE BULLEN PT AK AK2570028652										SZ362D DRMO ANCHORAGE BLDG 22-009 ELMENDORF AFB, AK AK8570028649										MARK FOR PROJECT HW										TOTAL PRICE DOLLARS CTS																			
WAREHOUSE LOCATION										TYPE OF CARGO		UNIT PACK		UNIT WEIGHT		UNIT CUBE		U F C		N M F C		FREIGHT RATE		DOCUMENT DATE		MAT COND		QUANTITY		E																			
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SUBSTITUTE DATA (ITEM ORIGINALLY REQUESTED)										FREIGHT CLASSIFICATION NOMENCLATURE										U										V																			
4-55 GALLON DRUMS										HAZARDOUS WASTE, N.O.S. NA9189, ORME										W										X																			
50 gallons										SOLIDIFIED OILY WATER - NO LIQUIDS										Y										Z																			
SELECTED BY AND DATE										TYPE OF CONTAINER(S)										TOTAL WEIGHT										RECEIVED BY AND DATE										INSPECTED BY AND DATE									
1										55-GALLON DRUMS										3										7										8									
PACKED BY AND DATE										NO OF CONTAINERS										TOTAL CUBE										WAREHOUSED BY AND DATE										WAREHOUSE LOCATION									
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REMARKS										AA										BB										CC										DD									
FIRST DESTINATION ADDRESS										DATE SHIPPED										THE ABOVE NAMED MATERIAL IS PROPERLY IDENTIFIED, DESCRIBED, PACKAGED, MARKED AND LABELED AND IS IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO EPA REGULATIONS (40 CFR PARTS 250-265 AND PART 761) AND DOT REGULATIONS (49 CFR PARTS 170-189)										EE																			
TRANSPORTATION CHARGEABLE TO										14 B/LADING A/WB OR RECEIVER'S SIGNATURE (AND DATE)										15 RECEIVER'S DOCUMENT NUMBER										GG																			
SIGNED 15/										DATE 10-3-88										HH										II																			
DD FORM 1348-1 (4 PART)										1 MAR 74										DOD SINGLE LINE ITEM RELEASE/RECEIPT DOCUMENT										JJ																			

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1-55 GALLON DRUM										WASTE, COMBUSTIBLE LIQUID N.O.S. NA1270, COMBUSTIBLE LIQUID																																																																					
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										SIGNED 15/										DATE 10-3-58																																																											

DD FORM 1348-1
(4 PART)

1 MAR 74

DOD SINGLE LINE ITEM RECEIPT/RECEIPT DOCUMENT

DOC IDENT		AL FROM		M & S		STOCK NUMBER		FSC		NIN		ADD		UNIT OF ISSUE		QUANTITY		DOCUMENT NUMBER		REQUISITIONER		DATE		SERIAL		SUPPLEMENTARY ADDRESS		FUND		DISTRIBUTION		PROJECT		PRIORITY		RECEIVED DATE		ADVISE		UNIT PRICE		DOLLARS		CTS																									
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WAREHOUSE LOCATION				TYPE OF CARGO	UNIT PACK	UNIT WEIGHT	UNIT CUBE	U F C	N M F C	FREIGHT RATE	DOCUMENT DATE	MAT COND	QUANTITY	E	I							
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TRANSPORTATION CHARGEABLE TO				SIGNATURE						DATE												
DD FORM 1348-1 (4 PART)				1 MAR 74						DOD SINGLE LINE ITEM RELEASE/RECEIPT DOCUMENT												

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SUBSTITUTE DATA (ITEM ORIGINALLY REQUESTED)										FREIGHT CLASSIFICATION NOMENCLATURE																																																																																																																							
3-55 GALLON DRUMS										PETROLEUM OIL NA 1270, COMBUSTIBLE LIQUID																																																																																																																							
T										U																																																																																																																							
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										NEW (UNUSED) HDO-30 LUBE OIL																																																																																																																							
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SELECTED BY AND DATE										TYPE OF CONTAINER(S)										TOTAL WEIGHT										RECEIVED BY AND DATE										INSPECTED BY AND DATE																																																																																									
1										55 GALLON DRUMS										3										7										8																																																																																									
PACKED BY AND DATE										NO OF CONTAINERS										TOTAL CUBE										WAREHOUSED BY AND DATE										WAREHOUSE LOCATION																																																																																									
4										3										6										9										10																																																																																									
REMARKS																																																																																																																																	
AA										BB										CC										DD										EE										FF										GG																																																																					
FIRST DESTINATION ADDRESS										DATE SHIPPED										THE ABOVE NAMED MATERIAL IS PROPERLY IDENTIFIED DESCRIBED, PACKAGED, MARKED AND LABELED AND IS IN PROPER CONDITION FOR TRANSPORTATION ACCORDING TO EPA REGULATIONS (40 CFR PARTS 260-265 AND PART 761) AND DOT REGULATIONS (49 CFR PARTS 170-189)																																																																																																													
1										12										13										14										15										16																																																																															
3 TRANSPORTATION CHARGEABLE TO										14 B/LADING: AWB OR RECEIVER'S SIGNATURE (AND DATE)										15 RECEIVER'S DOCUMENT NUMBER																																																																																																													
										SIGNED 151										DATE 10-3-88																																																																																																													
0 FORM 1348-1 (4 PART)										1 MAR 74										DOD SINGLE LINE ITEM RELEASE/RECEIPT DOCUMENT																																																																																																													

Rocky Mountain Analytical

CHAIN OF CUSTODY

No. 3932 ^{1/3}

SAMPLE SAFE™ CONDITIONS

Colorado 80002
216611 Facsimile 303/431-7171

Attn: M. McDevitt

Enseco Client Woodward-Clyde Consultants
Project 90275J Barter
Sampling Co WCC
Sampling Site Barter Island
Team Leader K. Susewind

- 1 Packed by _____ Seal # 5
- 2 Seal Intact Upon Receipt by Sampling Co Yes No Unknown
- 3 Condition of Contents OK
- 4 Sealed for Shipping by R Spencer
- 5 Initial Contents Temp Unknown Seal # 1
- 6 Sampling Status Done Continuing Until 8/25/88
- 7 Seal Intact Upon Receipt by Laboratory Yes No
- 8 Contents Temperature Upon Receipt by Lab. _____ °C
- 9 Condition of Contents: _____

Date	Time	Sample ID/Description	Sample Type	No Containers	Analysis Parameters	Remarks
8/18/88	1025	1042-SO-001; 65-88-0001 (BARM-SL3)	soil	3	8240, 8080, 418.1 6010, D2216	
	1625	1042-SO-004; 65-88-0001 (BARM-OL1)	soil	5	8240, 8080, 418.1 6010, 418.1	matrix Spike & matrix Spike Dep inc
	1600	1042-SO-005; 65-88-0001 (BARM-OL2)		3		
	1540	1042-SO-006; 65-88-0001 (BARM-OL4)		3		
	1525	1042-SO-007; 65-88-0001 (BARM-OL5)		3		
	1525	1042-SO-007; 65-88-0003 (BARM-OL5)		3		
	1245	1042-SO-009; 65-88-0001 (BARM-NL1)		3		
	1300	1042-SO-010; 65-88-0001 (BARM-NL2)		3		
	1230	1042-SO-011; 65-88-0001 (BARM-NL3)		3		
	1220	1042-SO-012; 65-88-0001 (BARM-NL4)		3		

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed) Robyn K. Deena Received by (signed) _____ Date 8/18/88 Time 2100
2 _____
3 _____

SHIPPING DETAILS

Delivered to Shipper by R Spencer
Method of Shipment Gold Streak via Martin Air Airbill # 1518-6990
Received for Lab Rmay Signed B May Date/Time 0900
Enseco Project No 8-22-88

White and Pink Copies to Lab

Yellow to Sampler

55 (01)

46 392

Enseco - Rocky Mountain Analytical**CHAIN OF CUSTODY**

SAMPLE SAFE™ CONDITIONS

No. 3922 2/3

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Facsimile 303/431-7171

Attn: M. McDavittEnseco Client Woodward-Clyde ConsultantsProject 90275 JSampling Co WCCSampling Site Baxter IslandTeam Leader K. Jusewind

1. Packed by: _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co: Yes _____ No Unknown
3. Condition of Contents: OK
4. Sealed for Shipping by: R. Spencer
5. Initial Contents Temp.: Unknown °C Seal # 1
6. Sampling Status: Done _____ Continuing Until 8/25/88
7. Seal Intact Upon Receipt by Laboratory: Yes _____ No _____
8. Contents Temperature Upon Receipt by Lab: _____ °C
9. Condition of Contents: _____

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/18/88	1700	1042-SO-013; GS-88-0001 (BARM-PB1)	SOIL	1	418.1; D2216	
	1700	1042-SO-013; GS-88-0002 (BARM-PB2)				
	1710	1042-SO-014; GS-88-0001 (BARM-PB3)				
	1727	1042-SO-015; GS-88-0001 (BARM-PB3)				
	1740	1042-SO-016; GS-88-0001 (BARM-PB4)				
	1717	1042-SO-017; GS-88-0001 (BARM-PB5)				
	1732	1042-SO-018; GS-88-0001 (BARM-PB6)				
	1748	1042-SO-019; GS-88-0001 (BARM-PB7)				
	1120	1042-SO-020; GS-88-0001 (BARM-CD1)		3	8240, 8080, 418.1, 6010, D2216	
	1100	1042-SO-021; GS-88-0001 (BARM-CD2)		3		

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by: (signed) _____ Received by: (signed) _____ Date _____ Time _____

1. R. Spencer _____ 8/18/88 2100

2. _____

3. _____

SHIPPING DETAILSDelivered to Shipper by: R. SpencerMethod of Shipment: Gold Shrek via Martin Air Airbill # 1518-6990Received for Lab. RMAZ Signed: YB Mayo Date/Time 8/22/88

Enseco Project No. _____

1-258

16-80002

Facsimile. 303/431-7171

m McDeyitt

Enseco Client Woodward-Clyde Conso Harbors
Project 90275 T

Project 90275 J Super Consultants

Sampling Co. WCC

Sampling Site Baxter Island

Team Leader K. SUSEWIND

SAMPLE SAFE™ CONDITIONS

No. 3923
3/3

1. Packed by: _____ Seal # _____

2. Seal Intact Upon Receipt by Sampling Co. Yes _____ No UNKNOWN

3. Condition of Contents: OK

4. Sealed for Shipping by: PSYCHIC

5. Initial Contents Temp.: unknown °C Seal # 1

6. Sampling Status: Done _____ Continuing Until ± 8/25/88

7. Seal Intact Upon Receipt by Laboratory. Yes _____ No _____

8. Contents Temperature Upon Receipt by Lab: _____ °C

9. Condition of Contents: _____

[illegible]

Relinquished by: (signed)

Acquired by (signed)
Robert Kennedy

Received by (signed) _____

Date 1/8/88 Time 2:00

SHIPPING DETAILS

Delivered to Shipper by. Spencer **SHIPPING DETAIL**

Method of Shipment Gold Streak via Martin Air Airbill # 1518-6990
Received for Lab Ym d u

Received for Lab. Enzo Signed B. J. [Signature] Date/Time 0900

Enseco Project No. _____ Signed: B. J. [Signature] Date/Time 0900
822

White and Pink Copies to Lab

Yellow to Sampler

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Facsimile: 303/431-7171

Attn: M. McDevitt

Enseco Client Woodward Clyde Consultants

Project 90275J

Sampling Co. WCC

Sampling Site Barter Island

Team Leader K SUSEWINDO

CHAIN OF CUSTODY

SAMPLE SAFE™ CONDITIONS

No. 3273

1. Packed by: _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co.: Yes _____ No Unknown
3. Condition of Contents: OK
4. Sealed for Shipping by: R. Spencer
5. Initial Contents Temp.: Unknown °C Seal # _____
6. Sampling Status: Done _____ Continuing Until ± 8/25/80
7. Seal Intact Upon Receipt by Laboratory: Yes _____ No _____
8. Contents Temperature Upon Receipt by Lab. _____ °C
9. Condition of Contents: _____

Date	Time	Sample ID/Description	Sample Type	No Containers	Analysis Parameters	Remarks
8/21/88	1130	1042-NS-013; GN-88-0002 (BAR-M-PB1)	water	2 ✓	418.1	01
8/21/88	1145	1042-NS-014; GN-88-0002 (BAR-M-PB2)	WATER	2 ✓	418.1	02
8/21/88	1205	1042-NS-015; GN-88-0002 (BAR-M-PB3)	WATER	2 ✓	418.1	03
8/21/88	1220	1042-NS-016; GN-88-0002 (BAR-M-PB4)	water	2 ✓	418.1	04
8/21/88	11:43	1042-NS-021; GN-88-0002 (BAR-M-CD2)	water	2 7 *	8080, 418.1 6010 (total) 6010 (dil) 9132	05
8/21/88	11:43	1042-NS-021; GN-88-0003 (BAR-M-CD2)	water	2 5 *	8080, 418.1, 9132	06
			* actual	count received	8-24-88 JAA	

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by: (signed) Received by: (signed) Date Time

	NAME	DATE	TIME
1	Robert Kennedy	8-21-88	2100
2			
3			

SHIPPING DETAILS

Delivered to Shipper by: Spencer
Method of Shipment: Cold Streak via Martin Air Airbill # 1517-5101
Received for Lab: HLA Signed: [Signature] Date/Time: 12/3/88
Enseco Project No. _____

Attn: M. McDewitt

CHAIN OF CUSTODY

No. 3275


SAMPLE SAFE™ CONDITIONS

1. Packed by _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co.: Yes No Unknown
3. Condition of Contents OK
4. Sealed for Shipping by ESponcer
5. Initial Contents Temp. Unknown °C Seal # 27
6. Sampling Status Done Continuing Until 8/25/88
7. Seal Intact Upon Receipt by Laboratory. Yes No
8. Contents Temperature Upon Receipt by Lab. _____ °C
9. Condition of Contents: _____

Enseco Client Woodward-Clyde Consultants
Project 90275 T
Sampling Co. WCC
Sampling Site Baker Island
Team Leader K. Susewind

[illegible]

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed)	Received by (signed)	Date	Time
1 	_____	6/7/03	2120
2 _____	_____	_____	_____
3 _____	_____	_____	_____

SHIPPING DETAILS

Delivered to Shipper by: Spencer
Method of Shipment: Gold Streak via Martin Air Airbill # 1517-5101
Received for Lab: RMA Signed: P. R. [Signature] Date/Time: 8/23/88
Enseco Project No. _____

Enseco - Rocky Mountain Analytical

 4955 Yarrow Street
 Arvada, Colorado 80002
 303/421-6611 Facsimile: 303/431-7171

 Attn: M. McDevitt
CHAIN OF CUSTODY

No. 3266

SAMPLE SAFE™ CONDITIONS

- 1 Packed by: _____ Seal # _____
- 2 Seal Intact Upon Receipt by Sampling Co: Yes YES No unknown
- 3 Condition of Contents: OK
- 4 Sealed for Shipping by: R. Spencer
- 5 Initial Contents Temp.: Unknown °C Seal # _____
- 6 Sampling Status: Done Continuing Until 8/25/86
- 7 Seal Intact Upon Receipt by Laboratory: Yes _____ No _____
- 8 Contents Temperature Upon Receipt by Lab: _____ °C
- 9 Condition of Contents: _____

 Enseco Client Woodward-Clyde/Census Hants
 Project 90275J
 Sampling Co WCC
 Sampling Site Barter Island
 Team Leader K. Susewind

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/21/86	1345	1042-NS-012, GN-88-0002 (BARM-NL4)	water	6	2080, 418.1, 6010 (total) 6010 (dissolved)	09
	1345	1042-NS-012, GN-88-0003 (BARM-NL4)	↓	6	↓	24
	950	1042-NS-020, GN-88-0002 (BARM-CD1)	↓	7	8080, 418.1, 6010 (total) 6010 (dissolved), 9132	10
	1143	1042-NS-027, GN-88-0002 (BARM-CD3)	↓	7	↓	25

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by: (signed)	Received by: (signed):	Date	Time
1 <u>R. Spencer</u>		8/21/86	2100
2 _____			
3 _____			

SHIPPING DETAILS

Delivered to Shipper by: <u>R. Spencer</u>	
Method of Shipment: <u>Gold Streak via Martin Air</u>	Bill # <u>1517-5101</u>
Received for Lab: <u>RITA</u>	Signed: <u>[Signature]</u> Date/Time: <u>8/25/86</u>
Enseco Project No. _____	

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Facsimile: 303/431-7171

Attn: M. McDevitt

Enseco Client Woodward-Clyde Consultants

Project 90275J

Sampling Co. WCC

Sampling Site Barter Island

Team Leader K. Susewind

CHAIN OF CUSTODY

No. 3274

SAMPLE SAFE™ CONDITIONS

- Packed by: _____ Seal # _____
- Seal Intact Upon Receipt by Sampling Co.: Yes ☐ No ☒ Unknown
- Condition of Contents: OK
- Sealed for Shipping by: P. Spencer
- Initial Contents Temp.: unknown °C Seal # _____
- Sampling Status: Done ☐ Continuing Until 8/25/88
- Seal Intact Upon Receipt by Laboratory: Yes ☐ No ☐
- Contents Temperature Upon Receipt by Lab: _____ °C
- Condition of Contents: _____

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters *	Remarks
8/21/88	1415	1042-NS-010; GN-88-0002 (BARM) NL2	water	10	8010 8020 8080 418.1 6010 T61 6010 Diss	11
	1440	1042-NS-009; GN-88-0002 (BARM) NL1		22	8010 8020 8080 418.1 6010 T61 6010 Diss (MS/MSD)	12
	1315	1042-NS-001; GN-88-0002 (BARM NL3)		4	8010, 8020	13
	1345	1042-NS-012; GN-88-0002 (BARM NL4)		4		14
	1345	1042-NS-012; GN-88-0003 (BARM NL4)		4		15
	0950	1042-NS-020; GN-88-0002 (BARM CO1)		4		16
	1040	1042-NS-021; GN-88-0002 (BARM CO2)		4		17
	1143	1042-NS-022; GN-88-0002 (BARM CO3)		4		18
	1945	Trip Blank		3		19
	1136	Field Blank		4		20

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by: (signed) P. Spencer Date 8/21/88 Time 2100
Received by: (signed) _____
1 _____
2 _____
3 _____

SHIPPING DETAILS

Delivered to Shipper by: P. Spencer
Method of Shipment: Cold Streak via Martin Air Airbill # 1517-5101
Received for Lab: PCA Signed: P. Spencer Date/Time: 8/21/88
Enseco Project No. _____

Enseco - Rocky Mountain Analytical

4935 Yarrow Street
Arvada, Colorado 80002
303/421-6611 . Facsimile: 303/431-7171

Attn: M. McDevitt

Enseco Client: Woodward-Clyde Consultants

Project 90275 J

Sampling Co. WCC

Sampling Site: Barker Island

Team Leader K. Susewini

CHAIN OF CUSTODY

SAMPLE SAFE™ CONDITIONS

No. 3264

1. Packed by: _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co.: Yes No Unknown
3. Condition of Contents: OK
4. Sealed for Shipping by: Spencer
5. Initial Contents Temp: unknown °C Seal # _____
6. Sampling Status: Done Continuing Until 8/25/80
7. Seal Intact Upon Receipt by Laboratory: Yes No
8. Contents Temperature Upon Receipt by Lab: _____ °C
9. Condition of Contents: _____

[illegible]

CUSTODY TRANSFERS PRIOR TO SHIPPING

Retinquished by: (signed)

Received by: (signed) _____

Date Time

[Signature]

8/21/02 2100

SHIPPING DETAILS

Delivered to Shipper by:

Method of Shipments Gold Strak via Martin Air

Arbilla # 1517-5101

Received for Lab

Signed: B. Mason

Date/Time

-Enesco Project No. _____

8-23-88

White and Pink Copies to Lab Yellow to Sampler

85-00

10:55 AM

KEY MTN ANALYTICAL

Page 20

15	359
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1340

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
 Arvada, Colorado 80002
 303/421-6611 Facsimile: 303/431-7171

Attn: M. McDevitt

Enasco Client Woodward-Clayton Const

- Project 90275J

Sampling Co. WCC

Sampling Site Barter Island

Team Leader K. Susewind

CHAIN OF CUSTODY

SAMPLE SAFE™ CONDITIONS

No. 3276

1. Packed by: _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co.: Yes _____ No Unknown
3. Condition of Contents: OK
4. Sealed for Shipping by: R. Spencer
5. Initial Contents Temp.: Unknown °C Seal # _____
6. Sampling Status: Done _____ Continuing Until 8/25/88
7. Seal Intact Upon Receipt by Laboratory: Yes _____ No _____
8. Contents Temperature Upon Receipt by Lab: _____ °C
9. Condition of Contents: _____

[illegible]

CUSTODY TRANSFERS PRIOR TO SHIPPING.

Relinquished by: (signed) _____ Received by: (signed) _____ Date: 8/24/00 Time: 2:00
1 _____
2 _____
3 _____

SHIPPING DETAILS

Delivered to Shipper by: K. Spencer
Method of Shipment: Gold Streak via North Air Airbill # 1517-5101
Received for Lab: Lma, Y Signed: B. Mason Date/Time: 7/20/82
Enasco Project No. _____

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Facsimile: 303/431-7171

Attn: JOHN ZIMMERMAN

Enseco Client WOODWARD-CLYDE

Project DEW LINE

Sampling Co WCC

Sampling Site BULLEN POINT

Team Leader CHRIS VAIS

CHAIN OF CUSTODY

SAMPLE SAFE™ CONDITIONS

No. 1227

- Packed by: SRLAWN Seal # _____
- Seal Intact Upon Receipt by Sampling Co: Yes _____ No _____
- Condition of Contents: _____
- Sealed for Shipping by: SRLAWN
- Initial Contents Temp.: _____ °C Seal # _____
- Sampling Status: Done _____ Continuing Until _____
- Seal Intact Upon Receipt by Laboratory: Yes _____ No _____
- Contents Temperature Upon Receipt by Lab: _____ °C
- Condition of Contents: _____

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
9/12/88	1420	1062-NS-0002-GN-88-0002	WATER	9	8010, 8020, 8080, 418.1 6010 (F), 6010 (D)	EXTRA VOA BOTTLES FOR BLENDING
"	1435	1062-SO-005-GS-88-0001	SEDIMENT	3	8240, 6010 8080, 418.1, ASTM D2216	
"	1455	1062-SO-006-GS-88-0001	"	3	" " "	
"	1455	1062-SO-006-GS-88-0002	"	3	8240, 6010 8080, 418.1	
"	1700	1062-SO-007-GS-88-0001	SOIL	1	8080	
"	1715	1062-SO-008-GS-88-0001	"	1	8080	
"	1730	^{NS} 1862- SS -009-GN-88-0001	OIL	1	8080	TRANSFORMER OIL
"	1445	1062-NS-010-GN-88-0001	WATER	4	8010, 8020	EXTRA VOA BOTTLES FOR BLENDING
"	—	1062-NS-011-GN-88-0001	WATER	4	8010, 8020	TRIP BLANK

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by: (signed)

Received by: (signed)

Date Time

1 Stacey Brown

9/13/88 1805

2 _____

3 _____

SHIPPING DETAILS

Delivered to Shipper by: _____

Method of Shipment: _____

Airbill # _____

Received for Lab: Emad

Signed: B. Mason

Date/Time 9-14-88

Enseco Project No. _____

12 307

White and Pink Copies to Lab

Yellow to Sampler

SS 001

46 402

1712

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
 Arvada, Colorado 80002
 303/421-6611 Facsimile: 303/431-7171

Attn: JEAN ZIMMERMAN**CHAIN OF CUSTODY**

No. 1228

SAMPLE SAFE™ CONDITIONS

1. Packed by: S BROWN Seal # _____
2. Seal Intact Upon Receipt by Sampling Co.: Yes _____ No _____
3. Condition of Contents: _____
4. Sealed for Shipping by: S BROWN
5. Initial Contents Temp.: _____ °C Seal # _____
6. Sampling Status: Done _____ Continuing Until _____
7. Seal Intact Upon Receipt by Laboratory: Yes _____ No _____
8. Contents Temperature Upon Receipt by Lab: _____ °C
9. Condition of Contents: _____

Enseco Client WOODWARD-CLYDE

Project DEW LINE

Sampling Co. WCC

Sampling Site BULLEN POINT

Team Leader CARIS VAIS

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
9/12/88	1345	1062-NS-001-GN-88-0001	WATER	9	8010, 8020, 8080, 418.1 6010 (T), 6010 (D)	EXTRA VOA BOTTLES FOR BREAKAGE
"	1420	1062-NS-002-GN-88-0001	"	9	" " "	" "
"	1355	1062-SO-003-GS-88-0001	SEDIMENT	3	8040, 6010 8080, 418.4, nsm 0004	
"	1405	1062-SO-004-GS-88-0001	"	3	" " "	

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by: (signed) _____ Date _____ Time _____

Received by: (signed) _____

1 [Signature] _____ 9/13/88 1800

2 _____

3 _____

SHIPPING DETAILS

Delivered to Shipper by: _____

Method of Shipment: _____ Airbill # _____

Received for Lab: WMAZ Signed: [Signature] Date/Time 9-14-88
10:30

Enseco Project No. _____

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Facsimile: 303/431-7171

Attn: M McDevitt

Enseco Client WOODWARD CLYDE CONSULTANTS

Project 90275 J

Sampling Co WCC

Sampling Site POINT LONELY DEW LINE STA

Team Leader H. SUSEWIND

CHAIN OF CUSTODY

SAMPLE SAFE™ CONDITIONS

No. 1154

- Packed by K Mobley Seal # _____
- Seal Intact Upon Receipt by Sampling Co Yes No UNKADJ
- Condition of Contents OK
- Sealed for Shipping by K Mobley
- Initial Contents Temp. UNK °C Seal # _____
- Sampling Status Done Continuing Until 8/25/88
- Seal Intact Upon Receipt by Laboratory Yes No
- Contents Temperature Upon Receipt by Lab _____ °C
- Condition of Contents _____

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/24/88	1615	1060-NS-008; LN-88-0002 (POW-1 HL-1)	WATER SURFACE	10	8025, 8010 6010 TOTAL 6010 dissolved 418.1	13 *
8/24/88	1615	1060-SO-008; GS-88-0001 (POW-1 HL-2)	SOIL	5	8240 8080 418.1	14, MS, MSD *
8/24/88	0730 1615	1060-EB (POW-1)	WATER	8	6010 D2216 8010 8026 8080 418.1	15 (+)
8/24/88	1815	1060 TB (POW-1)	WATER	3	8010 8026	16
8/24/88	1545	1060-SO-009; GS-88-0001 (POW-1 HL-4)	SOIL	3	8240 8080 418.1 6010 D2216	17
8/24/88	1545	1060-SO-009; GS-88-0002 (POW-1 HL-4)	SOIL	3	8240 8080 418.1 6010 D2216	18
<p>* 1/17/MSD per bottle 8-28-88 8240, 8080 only</p> <p>* Bottle label calls for 8080 (#13) (2 bottles sent)</p> <p>(+) No bottles sent for 418.1</p>						

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed)	Received by (signed)	Date	Time
1 <u>[Signature]</u>		8/24/88	2005
2 _____			
3 _____			

SHIPPING DETAILS

Delivered to Shipper by _____	Airbill # _____
Method of Shipment _____	
Received for Lab. <u>RMA</u>	Signed <u>[Signature]</u> Date/Time <u>8/26/88</u>
Enseco Project No _____	10 '23

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421 6611 Facsimile 303/431-7171

Attn: M McDevitt

Enseco Client WOODWARD-CLYDE CONSULTANTS

Project 90275J

Sampling Co. WCC

Sampling Site POINT LONELY DRAW LINE STA.

Team Leader K SUSEWINO

CHAIN OF CUSTODY

SAMPLE SAFE™ CONDITIONS

No. 1155

1. Packed by _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co. Yes _____ No Unknown
3. Condition of Contents OK
4. Sealed for Shipping by K Mahley
5. Initial Contents Temp Unk °C Seal # _____
6. Sampling Status Done _____ Continuing Until 8/25/88
7. Seal Intact Upon Receipt by Laboratory. Unk Yes _____ No _____
8. Contents Temperature Upon Receipt by Lab _____ °C
9. Condition of Contents _____

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/24/88	1545	1060-NS-007; 6N-88-0002 (POW-1 HL-3)	WATER	10	8010 8020 8080 418.1 6010 T ₁ 6010 dissolved	
8/24/88	1255	1060-NS-010; 6N-88-0002 (POW-1 HL-5)	WATER	10	8010 8020 8080 418.1 6010 T ₁ 6010 dissolved	
8/24/88	1225	1060-NS-011; 6N-88-0002 (POW-1 HL-7)	WATER	4	8010 8020	
8/24/88	1135	1060-NS-012; 6N-88-0602 (POW-1 HL-9)	WATER	4	8010 8020	
8/24/88	1135	1060-NS-012; 6N-88-0005 (POW-1 HL-9)	WATER	3	8010 8020	
8/24/88	2000	TRIP BLANK	WATER	3	8010 8020	
8/24/88	1255	1060-SO-010; 6S-88-0001 (POW-1 HLB)	SOIL	3	8240 8080 D2216 418.1 6010	1-33, 2-30
8/24/88	1225	1060-SO-011; 6S-88-0001 (POW-1 HLB)	SOIL	3	8240 8080 D2216 418.1 6010	
8/24/88	1135	1060-SO-012; 6S-88-0001 (POW-1 HLB)	SOIL	3	8240 6010 D2216 8080 418.1	

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed)	Received by (signed)	Date	Time
<u>[Signature]</u>		8/24/88	2015

SHIPPING DETAILS

Delivered to Shipper by _____

Method of Shipment: _____ Airbill # _____

Received for Lab: RMA Signed [Signature] Date/Time 8/26/88 10:23

Enseco Project No _____

No. 1156

SAMPLE SAFE™ CONDITIONS

simile 303/431-7171
Al McDevitt

1 Packed by: _____ Seal # _____
2 Seal Intact Upon Receipt by Sampling Co _____ Yes _____ No Unknown
3 Condition of Contents OK
4 Sealed for Shipping by K. Mobley
5 Initial Contents Temp unknown °C Seal # 01/25/88
6 Sampling Status Done _____ Continuing Until _____
7 Seal Intact Upon Receipt by Laboratory _____ Yes _____ No _____
8 Contents Temperature Upon Receipt by Lab _____ °C
9 Condition of Contents: _____

Enseco Client Woodward-Clyde Consultants
Project 90275J
Sampling Co WCC
Sampling Site Pt Lonely
Team Leader K Susewind

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/24/88	1225	1060-NS-011; GN-88-0002 (POW-1 HL-7)	water	6	8080, 418.1 6010 (total) 6010 (dissolved)	
↓	1135	1060-NS-012; GN-88-0002 (POW-1 HL-9)	↓	↓	↓ —	
↓	1135	1060-NS-013; GN-88-0003 (POW-1, HL-9)	↓	↓	↓ —	
		2nd line description not on bottle labels; not in Lims				
		8-28-88 JEH				

3-263

1
2
3

46 405

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed) _____ Received by (signed) _____ Date _____ Time _____

1 Yolanda K. Lopez _____ 8/24/88 2015

2 _____ _____ _____ _____

SHIPPING DETAILS

Delivered to Shipper by: _____
Method of Shipment: _____ Airbill # _____
Received for Lab: RMA Signed AB Date/Time 8/26/86

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421-6611 Facsimile: 303/431-7171

Attn: M McDEVITT

CHAIN OF CUSTODY

SAMPLE SAFE™ CONDITIONS

No. 3111 1/2

Enseco Client WOODWARD CLINE CONSULTANTS

Project 90275J

Sampling Co. WCC

Sampling Site POINT LONELY DEW LAKE

Team Leader K SUSEWING

1. Packed by: _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co. Yes ☒ No ☐
3. Condition of Contents. OK
4. Sealed for Shipping by: K Susewing
5. Initial Contents Temp: UNE °C Seal # _____
6. Sampling Status: Done ☒ Continuing Until ?
7. Seal Intact Upon Receipt by Laboratory: Yes ☐ No ☐
8. Contents Temperature Upon Receipt by Lab: _____ °C
9. Condition of Contents. _____

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/21/83	0933	1060-50-001; GS-88-0001 (POW-1 FS)	SOIL	1	418.1 D2216	0.1
	1005	1060-50-002; GS-88-0001 (POW-1 FS)		1		0.2
	0945	1060-50-003; GS-88-0001 (POW-1 FS)		1		0.3
	0955	1060-50-004; GS-88-0001 (POW-1 FS)		1		0.4
	0926	1060-50-005; GS-88-0001 (POW-1 FS)		1		0.5
	1045	1060-N6-005; GN-88-0002 (POW-1 FS)	WATER	2	418.1	0.6
	1020	1060-50-006; GS-88-0001 (POW-1 FS)	SOIL	1	418.1 D2216	0.7
	1145	1060-N6-006; GN-88-0002 (POW-1 FS)	WATER	2	418.1	0.8
	940	1060-N5-007; GN-88-0002 (POW-1 FS)		2		0.9
✓	940	1060-50-007; GS-88-0001 (POW-1 FS)	SOIL	1	418.1 D2216	1.0

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed)	Received by (signed)	Date	Time
1 <u>[Signature]</u>		8/24/83	1700
2 _____			
3 _____			

SHIPPING DETAILS

Delivered to Shipper by K Mobley
Method of Shipment Gold Streak via Air Smith Airbill # 1517-5160
Received for Lab. RMA Signed [Signature] Date/Time 8/24/83 1700
Enseco Project No. _____

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421 6611 Facsimile: 303/431 7171

Attn: M. McDevitt

Enseco Client Woodward-Clyde Consultants

Project 90275J

Sampling Co. WCC

Sampling Site Pt. Lonely

Team Leader K. Susewind

CHAIN OF CUSTODY

SAMPLE SAFE™ CONDITIONS

No. 1000

1. Packed by: _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co. Yes _____ No Unknown
3. Condition of Contents: OK
4. Sealed for Shipping by: R. Susewind
5. Initial Contents Temp: Unknown °C Seal # _____
6. Sampling Status Done _____ Continuing Until ?
7. Seal Intact Upon Receipt by Laboratory Yes _____ No _____
8. Contents Temperature Upon Receipt by Lab _____ °C
9. Condition of Contents: _____

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/25/88	1220	1060-SO-013; GS-BB-0001 (POW-1-SO-1)	soil	2	8080, 418.1	11
	1425	1060-SO-014; GS-BB-0001 (POW-1-SO-2)	soil	2	8080, 418.1	11
	1435	1060-SO-015; GS-BB-0001 (POW-1-SO-3)	soil	2	8080, 418.1	13
	1030	1060-SO-016; GS-BB-0001 (POW-1-PS-1)	soil	1	418.1	11
	1035	1060-SO-017; GS-BB-0001 (POW-1-PS-2)	soil	1		11
	1020	1060-SO-018; GS-BB-0001 (POW-1-PS-3)	soil	1		11
	1020	1060-SO-018; GS-BB-0002 (POW-1-PS-3)	soil	1		11
	1105	1060-SO-019; GS-BB-0001 (POW-1-PS-4)	soil	1		18
	1055	1060-SO-020; GS-BB-0001 (POW-1-PS-5)	soil	1		19
✓	1055	1060-SO-021; GS-BB-0001 (POW-1-PS-6)	soil	1		20

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed) K. Susewind Received by (signed) _____ Date 8/25/88 Time 2000

2 _____

3 _____

SHIPPING DETAILS

Delivered to Shipper by: R. Susewind

Method of Shipment ColdStream via Cape Sully Airbill # 1511-5160

Received for Lab. BNA Signed: 11 Date/Time _____

Enseco Project No _____

1403

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
 Arvada, Colorado 80002
 303/421-6611 Facsimile: 303/431-7171

Attn: M McDevitt

CHAIN OF CUSTODY

No. 33711

SAMPLE SAFE™ CONDITIONS

1. Packed by _____ Seal # _____
2. Seal Intact Upon Receipt by Sampling Co Yes ☒ No ☐
3. Condition of Contents: OK
4. Sealed for Shipping by PS, JAKE
5. Initial Contents Temp: UNKNOWN °C Seal # _____
6. Sampling Status Done ☒ Continuing Until ?
7. Seal Intact Upon Receipt by Laboratory Yes ☐ No ☐
8. Contents Temperature Upon Receipt by Lab. _____ °C
9. Condition of Contents: _____

Enseco Client Woodward-Clyde ConsultantsProject 902758Sampling Co WCCSampling Site Pt. LonelyTeam Leader R. Susewind

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/25/88	1105	1060-SO-022; GS-88-0001 (POW1-PS-7)	soil	1	418.1, D2216	27
	1025	1060-NS-023; GS-88-0001 (POW1-PS-6)	water	2	418.1,	28
	1455	1060-SO-024; GS-88-0001 (POW1-OL1)	soil	2	8080, 418.1, 60110, D2216	23
	1450	1060-SO-025; GS-88-0001 (POW1-OL2)	soil	2	↓	24
↓	1205	1060-NS-026; GS-88-0001 (POW1-SO-01)	water	4	418.1, 8080	25

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed) Robin K. Kona Received by (signed) _____ Date 8/25/88 Time 2:00

1 _____

2 _____

3 _____

SHIPPING DETAILS

Delivered to Shipper by PS, JAKE

Method of Shipment Gold Street via (exp) Sing Airbill # 1617-5160

Received for Lab R.M. Signed JTC Date/Time _____

Enseco Project No _____

Enseco - Rocky Mountain Analytical

4955 Yarrow Street
Arvada, Colorado 80002
303/421 6611 Facsimile 303/431-7171

Attn: M McDevitt

CHAIN OF CUSTODY

No. 3926 2/2

SAMPLE SAFE™ CONDITIONS

- 1 Packed by _____ Seal # _____
- 2 Seal Intact Upon Receipt by Sampling Co. Yes ☒ No ☐
- 3 Condition of Contents OK
- 4 Sealed for Shipping by K Nobley
5. Initial Contents Temp.: UNK °C Seal # _____
6. Sampling Status: Done ☒ Continuing Until 5
7. Seal Intact Upon Receipt by Laboratory Yes ☐ No ☐
- 8 Contents Temperature Upon Receipt by Lab: _____ °C
9. Condition of Contents: _____

Enseco Client WOODWARD CLYDE CONSULTANTS
Project 90275J
Sampling Co. WCC
Sampling Site POINT LANEY DFW LINE
Team Leader K SUSEWING

Date	Time	Sample ID/Description	Sample Type	No. Containers	Analysis Parameters	Remarks
8/21/88	1600	FIELD BLANK	WATER	4	8010 8020	
8/21/88	1604	TRIP BLANK	WATER	3	8010 8020	
	1205	1060-N6-026, 6N-88-0001 (POW-1 50-01)	WATER	4	8010 8020	#28 10/1/88
	1220	1060-50-013, 6S-88-0001 (POW-1 50-01)	SOIL	1	8240	11
	1455	1060-50-024, 6S-88-0001 (POW-1 DL)	↓	1	8240	213
	1450	1060-50-025, 6S-88-0001 (POW-1 DL)	↓	1	8240	214

CUSTODY TRANSFERS PRIOR TO SHIPPING

Relinquished by (signed)	Received by (signed)	Date	Time
1 <u>[Signature]</u>		8/21/88	1700
2 _____			
3 _____			

SHIPPING DETAILS

Delivered to Shipper by K Nobley
Method of Shipment Cold Storage via Cape Smyth Airbill # 1517 5168
Received for Lab RMA Signed [Signature] Date/Time 8/21/88
Enseco Project No _____

TAB

Appendix E

APPENDIX F
CORRESPONDENCE

STATE OF ALASKA

DEPT. OF ENVIRONMENTAL CONSERVATION

46 412

STEVE COWPER, GOVERNOR

(907) 452-1714

December 12, 1988

Northern Regional Office
1001 Noble Street
Suite 350
Fairbanks, Alaska 99701

Mr. Bob Aaserud
Woodward Clyde Consultants
500th 12th Street
Suite 100
Oakland, California 94607-4014

Dear Mr. Aaserud:

Re: Interim Cleanup Standards

The purpose of this letter is to provide you with a written discussion of our interim cleanup standards for petroleum contamination, as you have requested.

The department is actively working toward a statewide "how clean is clean" policy. During the interim period, as a formal policy position is being formulated, we are using an interim policy for soil contamination which is based largely on the California Leaking Underground Fuel Tank (LUFT) manual. This document presents some very good guidelines for arriving at allowable soil contamination levels based on parameters such as depth to groundwater, precipitation, and soil type. It is likely that a decision matrix such as this, but based more on Alaska conditions, will be part of the final state policy. A cleanup level in soils of 100 mg/kg total petroleum hydrocarbons will be required as a minimum in most instances. The cleanup standard for groundwater is based on the Maximum Contaminant Limit (MCL) for drinking water of 5.0 ug/l benzene. Risk assessment is a necessary step when there is a proposal to fall short of the water and soil cleanup levels at a given site. One aspect of "how clean is clean" which is not likely to change relates to free liquid hydrocarbons. It has been widely agreed that free liquid hydrocarbons must be removed.

Sincerely,



Richard Cormack
Environmental Field Officer

rc/pg
410.02.003

DRAFT 12/15/89

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
INTERIM GUIDANCE FOR SOIL AND GROUNDWATER CLEANUP LEVELS

A. Issue Statement:

Interim cleanup guidance for contaminated soil and groundwater remediation is necessary to ensure consistent cleanup levels are being applied by districts and regional program staff. However, it is recognized that varying cleanup levels may be appropriate for different regions of the state due to varying environmental conditions, such as permafrost, depth to groundwater, and precipitation levels. Final cleanup levels shall be determined by the Regional Supervisor based on site-specific conditions.

Staff should be aware that if a facility is regulated under RCRA, that RCRA corrective action and cleanup standards should enter into the development of final site cleanup levels.

B. Groundwater Cleanup Standards:

Authority: 18 AAC 70.020 (b)
18 AAC 70.050 (2)

1. Groundwater should be cleaned up to levels not exceeding the final or proposed maximum contaminant levels (MCL) for organic and inorganic chemicals specified in the May 22, 1989, Federal Register Vol. 54, No. 97 (40 CFR, Part 141), pages 22155 - 22157 (Appendix I).
2. If the groundwater is a current or potential source for public or private water systems, cleanup levels may be lowered to final or proposed secondary maximum contaminant levels (SMCL) for organic and inorganic chemicals specified in the May 22, 1989, Federal Register Vol. 54, No. 97 (40 CFR, Part 143), page 22160 (Appendix II). Secondary maximum contaminant levels are based on aesthetic properties such as odor and taste whereas MCLs are based on human health risks. For compounds such as xylenes, the SMCL maybe several hundred times lower than the MCL.
3. For organic and inorganic contaminants that have not been assigned a final or proposed MCL, cleanup

DRAFT 12/15/89

levels should be based on EPA Water Quality Criteria using a health risk factor of 10^{-6} .

4. Alternative Cleanup Levels (ACLS) may be adopted if a risk assessment approved by the department is performed. Risk assessments will not by themselves establish ACLs. Determination of cleanup levels is a risk management decision that must be made by the department based on results of a quantitative risk assessment and other pertinent information.

- a. Responsible Party (RP) Cleanups:

The RP may prepare at its own expense a risk assessment which shall include an assessment of both human health and environmental risks. Specific components of the risk assessment should include an exposure assessment, toxicity assessment, risk characterization, and justification of ACLs. Attached is a description of risk assessment requirements that may be followed in preparing risk assessments (Appendix III). The RP, at the department's discretion, must agree to reimburse the department for expenses incurred by the department if it chooses to contract for a risk assessment review. The Petroleum and Hazardous Substance Investigation Term Contract can be used for risk assessment reviews.

- b. Non-responsible Party (NRP) Cleanups:

The department has a duty to meet clean-up standards as resources permit. However, it is recognized that the department is not the responsible party and may not have sufficient resources (HB 470, LUST TRUST, program management staff) to clean up NRP sites to the proposed standards. The department should document for the record when ACLs are established or cleanup actions are delayed at specific sites due to limited resources.

- c. Proposed Soil Cleanup Standards:

1. Hazardous substances other than refined petroleum products.

Soil contaminated by hazardous substances other than refined petroleum products must be cleaned to

DRAFT 12/15/89

background levels or to levels that will not lead to groundwater contamination through leaching nor pose a risk to potential surface receptors. Soils meeting the definitions of RCRA hazardous wastes shall be treated and disposed of as required by RCRA.

The contaminant leaching assessment would include analysis of soil type using a uniform soils classification, logging of any horizon over six inches thick, an analysis of hydraulic conductivity, absorptive capacity, potential migratory routes, precipitation levels and depth to groundwater. The analysis should be conducted in accordance with a program or plan that has been submitted to and approved by the department before the assessment is conducted.

2. Refined petroleum products.

Soils contaminated by refined petroleum products must be cleaned up to levels identified by the Regional Supervisor. ADEC's Petroleum Contaminated Soil Cleanup Guidelines (Appendix IV) may be used for guidance in establishing cleanup levels. These guidelines also describe how to sample, analyze, and prepare final reports to ensure cleanup standards are met.

3. Alternative Cleanup Levels (ACLs)

As identified under B-4, a risk assessment may be conducted for a specific site to determine ACLs for contaminated soils.

APPENDIX I

FINAL AND PROPOSED MAXIMUM CONTAMINANT LEVELS (MCL)
FOR ORGANIC AND INORGANIC CONTAMINANTSOrganic ContaminantsContaminant

MCL (mg/l)

= ppm

Benzene	0.005
Carbon tetrachloride	0.005
1,2 Dichloroethane	0.005
Trichloroethylene	0.005
para-Dichlorobenzene	0.075
1,1-Dichloroethylene	0.007
1,1,1-Trichloroethane	0.2
Vinyl chloride	0.002
cis-1,2-Dichloroethylene	0.07
1,2-Dichloropropane	0.005
Ethylbenzene	0.7
Monochlorobenzene	0.1
o-Dichlorobenzene	0.6
Styrene	0.005/0.1
Tetrachloroethylene	0.005
Toluene	2
trans-1,2-Dichloroethylene	0.1
Xylenes (total)	10

APPENDIX I (cont.)

Synthetic Organic Contaminants

<u>Contaminants</u>	<u>MCL (mg/l)</u>
Alachlor	0.002
Aldicarb	0.01
Aldicarb sulfoxide	0.01
Aldicarb sulfone	0.04
Atrazine	0.003
Carbofuran	0.04
Chlordane	0.002
Dibromochloropropane	0.0002
2,4-D	0.07
Ethylene dibromide	0.00005
Heptachlor	0.0004
Heptachlor epoxide	0.0002
Lindane	0.0002
Methoxychlor	0.4
Polychlorinated biphenyls (PCBs) (as decachlorobiphenyl)	0.0005
Pentachlorophenol	0.2
Toxaphene	0.005
2,4,5-TP	0.05

APPENDIX I (cont.)

Inorganic Contaminants

<u>Contaminants</u>	<u>MCL (mg/l)</u>
Fluoride	4
Asbestos	7 Million Fibers/liter (longer than 10 μ m)
Barium	5
Cadmium	0.005
Chromium	0.1
Mercury	0.002
Nitrate*	10 (as Nitrogen)
Nitrite*	1 (as Nitrogen)
Selenium	0.05

*MCL for total nitrate and nitrite=10 mg/l

FINAL OR PROPOSED SECONDARY MAXIMUM CONTAMINANT LEVELS (SMCL)

<u>Contaminant</u>	<u>Level</u>	<i>Def'n. of secondary limit.</i>
Aluminum	0.05 mg/l	
Chloride	250 mg/l	
Color	15 color units	
Copper	1 mg/l	
Corrosivity	Non-corrosive	
o-Dichlorobenzene	0.01 mg/l	
p-Dichlorobenzene	0.005 mg/l	
Ethylbenzene	0.03 mg/l	
Fluoride	2 mg/l	
Foaming agents	0.5 mg/l	
Iron	0.3 mg/l	
Manganese	0.05 mg/l	
Odor	3 threshold odor number	
Pentachlorophenol	0.03 mg/l	
pH	6.5-8.5	
Silver	0.09 mg/l	
Styrene	0.01 mg/l	
Sulfate	250 mg/l	
Toluene	0.04 mg/l	
Total dissolved solids (TDS)	500 mg/l	
Xylenes (total)	0.02 mg/l	
Zinc	5 mg/l	

APPENDIX III

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

RISK ASSESSMENT GUIDELINES

Risk assessments will not by themselves establish alternative cleanup levels. Determination of cleanup levels is a risk management decision that must be made by ADEC based on results of a quantitative risk assessment and other pertinent information.

A draft document entitled **Risk Assessment** Guidance for Superfund Sites is about to be released by EPA OSWER and provides general risk assessment guidance. Anchorage Western District is currently evaluating a risk assessment aimed at developing alternative cleanup levels. They may be contacted for additional risk assessment guidance.

Risk assessments should generally address the following task elements, divided into the following five major headings:

- A. Exposure Assessment - The purpose of the Exposure Assessment is to identify routes by which receptors may be exposed to contaminants and to determine contaminant levels to which receptors may be exposed. The Exposure Assessment should:
 - (1) Identify the contaminants found at the site and their concentrations as well as their extent and locations;
 - (2) Identify possible transport pathways;
 - (3) Identify potential exposure routes;
 - (4) Identify potential receptors for each exposure route; and
 - (5) Estimate or calculate expected contaminant levels to which actual or potential receptors may be exposed.
- B. Toxicity Assessment - The purpose of the Toxicity Assessment is to define the applicable human health and environmental criteria for contaminants found at the site. The criteria should be defined for all potential exposure routes identified in the Exposure Assessment. Criteria for constituents and exposure routes shall be based upon criteria such as Proposed Maximum Contaminant Levels (PMCLs), Maximum Contaminant Levels (MCLs), Average Daily Intake values (ADIs), Unit Cancer Risk values (UCRs), organoleptic threshold levels, Ambient Water Quality Criteria for Protection of Human Health and for

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(b) non-carcinogenic risk.

- (2) Effects on the public welfare of exposure to the contamination which may include but not be limited to adverse effects on actually and potentially used water resources;
- (3) Environmental risks in areas which are or will be ultimately affected by the contamination including:
 - (a) other aquifers,
 - (b) surface waters,
 - (c) wetlands,
 - (d) sensitive wildlife habitats, and
 - (e) sensitive areas including, but not limited to, National Parks, National Wildlife Refuges, National Forests, State Parks, State Recreation Areas, State Game Refuges.

D. Justification for Alternative Cleanup Levels (ACLs) - The purpose of this section is to provide justification on a case-by-case basis for ACLs. Factors to be evaluated shall be, at a minimum:

- (1) The present and future uses of the affected aquifer and adjacent surface waters with particular consideration of the probability that the contamination is substantially affecting or will migrate to and substantially affect a public or private source of potable water;
- (2) Potential for further degradation of the affected aquifer or degradation of other connected aquifers;
- (3) The technical feasibility of achieving normal site cleanup levels based on a review of reasonably available technology;
- (4) Individual site characteristics, including natural rehabilitative processes; and
- (5) The results of the risk assessment.

DRAFT 12/15/89

Protection of Aquatic Life, and other relevant criteria as applicable. If there are no appropriate criteria available for the contaminants and exposure routes of concern, or the criteria are in an inappropriate format, the responsible party shall develop the criteria using equations and current scientific literature acceptable to toxicological experts and the Department. Criteria for the following exposure routes shall be defined or developed as applicable.

- (1) Potable water exposure route - Develop criteria for ingestion, dermal contact, inhalation of vapors and mists, utilizing applicable health criteria such as PMCLs, MCLs, ADIs, UCRs, organoleptic threshold levels, and other relevant criteria as applicable.
- (2) Non-potable domestic water usage exposure route - develop criteria for dermal contact, accidental or negligent ingestion by adults and children, inhalation of vapors and mists, ingestion of food crops irrigated with such water, lawn watering, ingestion by pets and livestock, and other related exposure.
- (3) Soil exposure route - develop criteria for ingestion, dermal contact, inhalation, ingestion by humans or animals of food crops grown in contaminated soils.
- (4) Non-potable surface water exposure - develop criteria for prevention of adverse effects on human health (e.g. dermal contact effects on humans utilizing the resource for recreational purposes) or the environment (e.g. toxic effects of the contaminants on aquatic or marine biota, bio-accumulative effects in the food chain, other adverse effects that may affect the designated use of the resource as well as the associated biota).
- (5) Air exposure route - develop criteria for exposure to the contaminants in their unaffected state.

C. Risk Characterization - The purpose of the Risk Characterization is to utilize the results of the Exposure Assessment and the Toxicity Assessment to characterize cumulative risks to the affected population and the environment from contaminants found at the site, a risk and impact evaluation will be performed which considers, but is not limited to:

- (1) Risks to human health and safety from the contamination including;
 - (a) carcinogenic risk, and

APPENDIX IV

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION PETROLEUM CONTAMINATED SOIL CLEANUP GUIDELINES

These guidelines identify numeric soil cleanup target levels for the remediation of motor fuel and heating oil releases. The identified cleanup levels are not regulations and are for guidance purposes only. They may be modified at the discretion of the Regional Supervisor depending on site-specific considerations. All spills must be reported to the local ADEC office as required under 18 AAC 75.080 and all cleanup actions must be conducted under the oversight and approval of the department.

These guidelines also describe how to collect soil samples, what laboratory analyses to perform, and how to prepare final reports to ensure cleanup levels are met for minor petroleum spills. The collection of soil samples and preparation of final reports must be conducted by a qualified, disinterested third party. Guidelines addressing the treatment, storage, and disposal of petroleum contaminated soils are currently being developed.

For minor petroleum spills, the Responsible Party (RP) must submit an Initial Corrective Action Plan which address: 1) soil excavation and sampling plans, 2) laboratory analyses and QA/QC procedures, and 3) contaminated soil treatment/disposal plans. Minor petroleum spills should be interpreted as those that have only resulted in soil contamination of which the total volume can be excavated and remediated. If groundwater or extensive amounts of soil have been contaminated, the RP must prepare a Contamination Assessment Plan and will probably need to prepare a Remedial Action Plan under the direction of the department.

SECTIONS

- Section I. Soil Cleanup Options
- Section II. Numeric Soil Cleanup Target Levels
- Section III. Sample Number and Location
- Section IV. Sample Collection Methods
- Section V. Required Analytical Methods
- Section VI. Evaluation of Analytical Results
- Section VII. Reporting Requirements

DEFINITIONS

"Gasoline" means any petroleum distillate used for motor fuel or heating oil which consists predominantly of hydrocarbons in the C4

DRAFT 12/15/89

- C12 range.

"Groundwater" means water in the zone of saturation, which is the zone below the water table, where all interstices are filled with water.

"Native soil" means the soil below fill material or outside of the immediate boundaries of the pit or trench that was originally excavated for the purpose of installing an underground storage tank, pipeline, or distribution system.

"Non-gasoline fraction" refers to diesel and any other petroleum distillate used for motor fuel or heating oil which consists predominantly of hydrocarbons greater than C12.

"Soil" means any unconsolidated geologic materials including, but not limited to, clay, loam, loess, silt, sand, gravel, tills or any combination of these materials.

SECTION I - SOIL CLEANUP OPTIONS

When cleaning up petroleum contaminated soils, the RP has the option of:

- A. Cleaning up the site to the numeric soil cleanup target levels identified by the Regional Supervisor, as outlined in Section II below; or
- B. Conducting a risk assessment, under the oversight and approval of the Regional Supervisor, to aid in determining alternative soil cleanup levels. The risk assessment should include the components outlined in Appendix III. The RP, at the department's discretion, must agree to reimburse the department for expenses incurred by the department if it chooses to contract for a risk assessment review.

SECTION II - NUMERIC SOIL CLEANUP TARGET LEVELS

The general soil cleanup target levels identified in part B below should be used as guidance in setting final soil cleanup levels. The identified levels may be modified by the Regional Supervisor based on site-specific conditions to ensure that residual levels of contamination will not lead to groundwater contamination. If soil contamination is in close proximity to the water table and presents a clear threat for groundwater contamination, the soil should be cleaned up to background levels, if possible.

- A. From an operational standpoint, all contaminated soil should be excavated at sites with limited contamination. Excavation would continue until no contamination, as determined with on-

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site monitoring devices, is detected in the remaining soils. Soil samples would then be collected and analyzed according to guidelines presented in Sections III, IV, and V. If laboratory results are below the soil cleanup target levels identified by the Regional Supervisor, then soil cleanup actions at the site may be determined adequate.

- B. The following table contains the soil cleanup target levels that should be used as guidance in establishing final cleanup levels. These levels are based on a measurement of total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations.

	<u>Gasoline</u>	<u>Non-Gasoline Product</u>
TPH	50 ppm	100 ppm
Benzene	0.5 ppm*	N/A
Toluene	2 ppm	N/A
Ethylbenzene	0.7 ppm	N/A
Xylenes	10 ppm	N/A
* 0.5 ppm is current detection level for benzene using methanol extraction		

- C. Cleanup levels for gasoline, which includes both TPH and BTEX, should be used for all sites unless a hydrocarbon identification test clearly shows that the contaminant is only diesel or another non-gasoline fraction hydrocarbon such as a heating oil. Under these conditions, the TPH value for non-gasoline products may be used as the target cleanup level and only TPH samples need to be taken and analyzed.
- D. Some sites may have naturally occurring organic compounds in the soil that result in elevated background levels of TPH via EPA Method 418.1. If a RP can satisfactorily demonstrate to the department that such elevated levels occur at a specific site, then the TPH cleanup levels can be increased by an amount equal to the elevated level for that site.

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SECTION III - SAMPLE NUMBER AND LOCATION

The collection and analysis of soil samples is required to verify that a site meets the requirements of these guidelines. These samples should represent the soils remaining at the site and should be collected after contaminated soils have been removed or remediated. Soil samples must be collected in accordance with a sampling plan and quality assurance/quality control (QA/QC) plan approved by the department before the initiation of field sampling. Contractors working at multiple sites having common characteristics (e.g. gasoline stations) may wish to get approval of generic sampling and QA/QC plans. Soil samples should be discrete grab samples.

A. The following criteria should be used to determine the number of soil samples collected from each spill site, tank pit, sump, or excavation.

- (1) For the removal of an individual tank, a minimum of three samples should be collected.
- (2) For the removal of multiple tanks from the same pit, a minimum of two samples should be collected for each tank. For tank excavations with more than 250 square feet of pit area, one additional sample should be collected for each additional 250 square feet of pit area. Pit area is determined by the ground surface area that has been excavated.
- (3) For surface spills where soil excavation has not occurred, a minimum of three samples should be collected. For spills with more than 250 square feet of affected area, one additional sample should be collected for each additional 250 square feet of affected area.
- (4) For sumps or excavations, a minimum of three samples should be collected. For sumps or excavations with more than 250 square feet of pit area, one additional sample should be collected for each additional 250 square feet of pit area. Pit area is determined by the ground surface area that has been excavated.

(For example, if there is 380 square feet of pit surface area, collect 4 samples and if there is 600 square feet of pit surface area, collect 5 samples.)

B. The following criteria should be used to determine the locations for soil samples collected from each spill site, sump, or excavation.

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- (1) Samples should be collected from the native soils located no more than two feet beneath the spill site, sump, or bottom of excavation in areas where contamination is most likely to be found.
 - (2) Samples should be taken from those areas where obviously stained or contaminated soils have been identified and excavated.
 - (3) If there are two or more distinct areas from which contaminated soils have been removed, then a minimum of two samples should be collected from each of these areas.
 - (4) For individual tank removals, samples should be taken from under the center and each end of the tank, if there are no areas of obvious contamination.
 - (5) For surface spills, sumps, or pipeline leaks samples should be collected from the known or suspected point of release.
 - (6) A field instrument sensitive to volatile organic compounds may be used to aid in identifying areas to be sampled. Field data from organic vapor monitoring instruments may not be substituted for laboratory analyses of the soil samples.
- C. In situations where leaks have been found in the piping, or in which released product has preferentially followed the fill around the piping, samples are to be collected from the native soils directly beneath the areas where obvious contamination has been removed. Samples should be collected at 20 lateral foot intervals when contamination occurs along pipeline corridors.
- D. If water is present in the excavation, the department must be notified as soon as possible and a determination should be made as to whether contamination is likely to have affected the groundwater outside the confines of the pit. To accomplish this, the following actions should be taken:
- (1) Purge the water from the tank pit and dispose of it in accordance with all currently applicable local, state, and federal requirements.
 - (2) If the pit remains dry for 24 hours, testing and cleanup may proceed according to the applicable sections of these soil cleanup guidelines.
 - (3) If water returns to the pit in less than 24 hours, a

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determination should be made as to whether contamination is likely to have affected the groundwater outside the confines of the pit as indicated below:

- (a) For the removal of an individual tank, soil samples are to be collected from the walls of the excavation next to the ends of the tank at the original soil/water interface. For the removal of multiple tanks from the same pit, a soil sample is to be collected from each of the four walls of the excavation at the original soil/water interface.
 - (b) At least one sample should be taken of the water in the pit.
 - (c) The soil samples should be analyzed for TPH and benzene, toluene, ethylbenzene and xylenes (BTEX). The water sample should be analyzed for BTEX by EPA Method 602. Results of these analyses must be submitted to the department.
 - (d) Based on the results of these analyses, the department will determine how the cleanup should proceed.
- E. In situations where all contaminated soil exceeding the target cleanup level is not excavated, the RP should submit a Contamination Assessment Plan to the department for its approval.

SECTION - IV SAMPLE COLLECTION METHODS

- A. The following information must be kept during the sampling events:
- (1) A sketch of the site must be made which clearly shows all of the sample locations and identifies each location with a unique sample identification code.
 - (2) Each soil and water sample must be clearly labeled with its sample identification code. A written record should be maintained which includes, but is not limited to: the date, time and location of the sample collection; the name of the person collecting the sample; how the sample was collected; and any unusual or unexpected problems encountered during the sample collection which may have affected the sample integrity.
 - (3) Formal chain-of-custody records must be maintained for each sample.

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- (4) Color photographs showing sample locations.
- B. If soil samples cannot be safely collected from an excavation, a backhoe may be used to remove a bucket of native soil from each of the sample areas. The soil is to be brought rapidly to the surface where samples are to be immediately taken from the soil in the bucket.
- C. The following procedures should be used for the collection of soil samples from open pits or trenches:
- (1) Just prior to collecting each soil sample, approximately three inches of soil should be rapidly scraped away from the surface of the sample location.
 - (2) To minimize the loss of volatile materials, samples are to be taken using a driven-tube type sampler. A clean brass or stainless steel tube of at least one inch in diameter and three inches in length may be used for this purpose. The tube should be driven into the soil with a suitable instrument such as a wooden mallet or hammer.
 - (3) The ends of the sample-filled tube should be immediately covered with clean aluminum foil. The aluminum foil should be held in place by plastic end caps which are then sealed onto the tube with a suitable tape such as duct tape.
 - (4) Alternatively, samples may be taken with a minimum amount of disturbance and packed in a clean 4-8 ounce wide-mouth glass jar. The sample jar must be filled to the top as to leave as little as possible headspace (air vapor) in the container. The sample jar is immediately sealed with a teflon-lined screw cap.
 - (5) After the samples are properly sealed, they are to be immediately placed on ice and maintained at a temperature of no greater than 4°C (39°F). Ice or artificial frozen blue ice may be used to maintain this temperature. This minimum temperature **MUST** be maintained until analysis at a laboratory. All samples **MUST** be analyzed within 14 days of collection.
- D. The department may approve alternative sampling methods which have been clearly shown to be at least as effective with respect to minimizing the loss of volatile materials during sampling and storage as the methods listed above.

SECTION V - REQUIRED ANALYTICAL METHODS

- A. The following table lists the USEPA methods to be used for the analysis of soil samples. All samples should be analyzed for TPH and BTEX unless a hydrocarbon identification test clearly shows that the contaminant is only diesel or another non-gasoline fraction hydrocarbon such as a heating oil. Under these conditions, samples only need to be analyzed for TPH. The department may adopt alternative analytical methods which have been clearly shown to be applicable for the compounds of interest and which have detection limits at least as low as the methods listed above.

<u>Parameters</u>	<u>Acronym</u>	<u>Method</u>	<u>Technique</u>
Total Petroleum Hydrocarbons	TPH	418.1	Infrared Spectroscopy (IR)
Benzene, Toluene, Ethylbenzene & Xylenes	BTE&X	5030*/ 8020	Purge & Trap Extraction for Aromatic Volatile Compounds by Gas Chromatography (GC)
		<u>OR</u> 8240	GC Mass Spectro- (GC/MS)
Hydrocarbon Identification**	HCID	8015	Gas Chromatography (GC)

*Use the method based on extracting the soil/sediment with methanol (high - level method) described in Section 7.3.3.2 in EPA Method 5030. Use a minimum 4 grams wet weight of the sample.

**Hydrocarbon identification by a chromatographic method is capable of identifying, in terms of the number of carbon atoms, the range of hydrocarbons present in the sample. This test only needs to be qualitative to determine hydrocarbon type rather than quantitative in estimating a concentration.

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- B. To document and verify the work performed by laboratories, specific elements of data reporting must be delivered to the department for each environmental sample submitted. These elements are outlined in Attachment A: "Petroleum Contamination Data Deliverables and Reporting Requirements." The submitting laboratory may alter the reporting format to make it compatible with their computer systems; however, the substantive data required to meet the intent of this package shall not change.

The Tier B data package deliverable was developed to ensure that the environmental data generated is of known quality and that EQM&LO data validation procedures to verify the results reported can be utilized.

SECTION VI - EVALUATION OF ANALYTICAL RESULTS

- A. Results of the soil analyses should be interpreted as follows:
- (1) If samples within a contiguous area have an average concentration less than or equal to the required cleanup level, the area represented by those samples should have met the requirements of these guidelines.
 - (2) If samples have an average concentration exceeding the required cleanup level by more than 10%, the area represented by those samples have not met the requirements of these guidelines. Further remediation, sampling and testing is necessary until the required level is attained.
 - (3) If samples have an average concentration exceeding the required cleanup level by less than 10%, the RP has the option of collecting and analyzing two more samples from the same area and using the average of all samples to determine if the standard has been met; or further remediating the area and then collecting and analyzing three new samples using the concentration of the new samples to determine if the standard has been met.
- B. A site should be considered sufficiently remediated when all of the sampled areas have concentrations less than or equal to the required cleanup level, all excavated soil has been properly treated and disposed of, and when the possibility of any human contact with the residual soil contamination remaining on the site has been precluded.
- C. If water is present in a tank pit, sump, or excavation, the department will decide if cleanup may proceed under these guidelines or if further action must be taken such as the

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preparation of a Contamination Assessment Report. This decision should be based on but not limited to:

- (1) The apparent extent of the contamination;
 - (2) The likelihood that groundwater contamination exists beyond the boundaries of the tank pit, sump, or excavation;
 - (3) The likelihood that the BTEX concentrations in the water and the BTEX and TPH concentrations in the soil indicate a situation which poses a threat to public health, safety, welfare and the environment; and
 - (4) Any other site-specific factors deemed appropriate by the department.
- D. If a pocket of contamination exceeding the required cleanup level is located under a building or other structure where further removal would endanger the structure or be prohibitively expensive, the department must be notified of this situation. The department will then decide whether such contamination can remain without threatening human health, safety, and welfare or the environment. If not, the department will require further remediation. Additionally, when the building is eventually removed, the department reserves the option of requiring additional soil cleanup measures.

SECTION VII - REPORTING REQUIREMENTS

- A. A RP must submit a final report to the department for a site that has been cleaned up according to these guidelines which should contain, but is not limited to:
- (1) All of the sampling documentation required in Section IV, A. above;
 - (2) Copies of the laboratory reports for all of the samples collected at the site, including samples that were too high and which required further action;
 - (3) An explanation of what was done in the case of any samples that initially exceeded the required cleanup levels;
 - (4) A summary of the concentrations measured in the final round of samples from each sampling location;
 - (5) Written confirmation that contaminated soil was stored,

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treated and/or disposed of in a manner consistent with the storage or disposal proposal contained in the Initial Corrective Action Plan previously approved by the department.

- (6) In cases where groundwater was present in a pit or excavation, a summary of the data collected; and
 - (7) In cases where pockets of excess contamination remain on site in accordance with Section VI, D., a description of this contamination including location, approximate volume and concentration.
- B. The RP should retain a copy of the report submitted to the department under this Section until the time of first transfer of the property, plus 10 years.
- C. Within 60 days after receipt of the final report under this Section, the department should:
- (1) Provide the person submitting the report a written statement that, based upon information contained in the report, the site was cleaned up to the satisfaction of the Regional Supervisor; or
 - (2) Request the RP to submit additional information or perform further investigation; or
 - (3) Request the RP to develop and submit a plan for further corrective action.

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

WATER QUALITY STANDARDS

18 AAC 70

**PREPARED FOR THE TRIENNIAL REVIEW
REQUIRED BY THE FEDERAL CLEAN WATER ACT**

DECEMBER 1989

NOTE: The official version of this document is printed in the Alaska Administrative Code, published by the Michie Company. If any discrepancies are found between this version and the published version, the published version will apply unless the discrepancy is an obvious error in the published version. The tables at 18 AAC 70.020 and at 18 AAC 70.050 have been restructured to enhance readability; no substantive changes have been made.

CHAPTER 70. WATER QUALITY STANDARDS**Section**

- 10. General
- 15. Short-term variance
- 20. Protected water use classes and criteria
- 25. Site-specific criteria
- 30. Procedure for applying water quality criteria
- 32. Mixing zones
- 33. Zones of deposit
- 34. Thermal discharges
- 40. (Consolidated into 18 AAC 70.010)
- 50. Classification of state waters
- 55. Procedure for reclassification
- 58. (Repealed)
- 60. (Repealed)
- 70. (Consolidated into 18 AAC 70.020)
- 80. (Consolidated into 18 AAC 72)
- 81. (Repealed)
- 82. (Repealed)
- 83. (Repealed)
- 84. (Repealed)
- 85. (Repealed)
- 86. Enforcement discretion
- 90. (Consolidated into 18 AAC 72)
- 100. (Repealed)
- 110. Definitions

18 AAC 70.010. GENERAL. (a) No person may conduct an operation that causes or contributes to a violation of the water quality standards set by this chapter.

(b) The water quality standards set by this chapter specify the degree of degradation that may not be exceeded in a water body as a result of human actions. The water quality standards are set by the antidegradation requirement of (c) of this section, and the water quality criteria of 18 AAC 70.020(b), applied in accordance with the remainder of this chapter.

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(b) The department will, in its discretion, grant a short-term variance by geographic area or project, or for a specific, individual event. The term of a variance will be as short as practicable, and will, at the latest, expire upon completion of the project.

(c) A person seeking a short-term variance shall submit a written request and proceed in accordance with 18 AAC 15.020 – 18 AAC 15.100. The request must state the location, time, duration, and type of activity for which the variance is sought; reasons why the activity is required; the areal extent and quantified degree of variance from the applicable criteria; detailed construction and operating plans, including water pollution control and mitigation measures; and an estimate of the activity's impact on the uses of the water involved, including recreation and use for habitat, rearing, growth, or migration by fish, shellfish, other aquatic life, and wildlife. In its discretion, the department will treat an application for a permit under Sec. 404 of the Clean Water Act as an application for a short-term variance. (Eff. 2/2/79, Register 69; am 4/23/79, Register 70; am 9/19/79, Register 71; am 1/7/87, Register 100)

Authority: AS 46.03.010
AS 46.03.070
AS 46.03.080

18 AAC 70.020. PROTECTED WATER USE CLASSES AND CRITERIA. (a)
Classes of use of the state's water protected by criteria set out under (b) of this section are

(1) Fresh water

(A) Water supply

- (i) drinking, culinary, and food processing,
- (ii) agriculture, including irrigation and stock watering,
- (iii) aquaculture,
- (iv) industrial;

(B) Water recreation

- (i) contact recreation,
- (ii) secondary recreation;

(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife; and

WATER QUALITY CRITERIA

The water quality criteria, when used in combination with the water use designation, constitute the water quality standard for a particular water body. The water quality standards regulate human activities which result in alterations to waters within the jurisdiction of the state.

I. FRESH WATER USES	FECAL COLIFORM BACTERIA (FC) (See Note 1)	DISSOLVED GAS
(A) Water Supply (i) drinking, culinary, and food processing	Based on minimum of 5 samples taken in a period of 30 days, mean shall not exceed 20 FC/100 ml, and not more than 10% of the samples shall exceed 40 FC/100 ml. For groundwater the FC concentration shall be less than 1 FC/100 ml when using the fecal coliform Membrane Filter Technique or less than 3 FC/100 ml when using the fecal coliform MPN technique.	Dissolved oxygen (D.O.) shall be greater than or equal to 4 mg/l (this does not apply to lakes or reservoirs in which supplies are taken from below the thermocline, or to groundwater).
(A) Water Supply (ii) agriculture, including irrigation, and stock watering	For products normally cooked and for dairy sanitation of pasteurized products, the mean, based on a minimum of 5 samples taken in a period of 30 days, shall not exceed 200 FC/100 ml, and not more than 10% of the samples shall exceed 400 FC/100 ml. For products not normally cooked and for dairy sanitation of unpasteurized products, the criteria for drinking water supply, 1(A)(i), shall apply.	D.O. shall be greater than 3 mg/l in surface waters.
(A) Water Supply (iii) aquaculture	For products normally cooked, the mean, based on a minimum of 5 samples taken in a period of 30 days, shall not exceed 200 FC/100 ml, and not more than 10% of the samples shall exceed 400 FC/100 ml. For products not normally cooked, the criteria for drinking water supply, 1(A)(i), shall apply.	D.O. shall be greater than 7 mg/l in surface waters. The concentration of total dissolved gas shall not exceed 110% of saturation at any point of sample collection.
(A) Water Supply (iv) Industrial	Where worker contact is present, the mean FC bacteria concentration, based upon a minimum of 5 samples taken in a 30 day period, shall not exceed 200 FC/100 ml, and not more than 10% of the samples shall exceed 400 FC/100 ml.	Shall not cause detrimental effects on established water supply treatment levels.
(B) Water Recreation (i) contact recreation	Based on a minimum of 5 samples taken in a 30 day period, the mean shall not exceed 20 FC/100 ml, and not more than 10% of the total samples shall exceed 40 FC/100 ml.	D.O. shall be greater than or equal to 4 mg/l.
(B) Water Recreation (ii) secondary recreation	Based on a minimum of 5 samples taken in a 30 day period, the mean shall not exceed 200 FC/100 ml, and not more than 10% of the total samples shall exceed 400 FC/100 ml.	D.O. shall be greater than or equal to 4 mg/l.
(C) Growth and Propagation of Fish, Shellfish, other Aquatic Life, and Wildlife	Not applicable.	D.O. shall be greater than 7 mg/l in waters used by anadromous and resident fish. In no case shall D.O. be less than 5 mg/l to a depth of 20 cm in the interstitial waters of gravel used by anadromous or resident fish for spawning (See Note 2). For waters not used by anadromous or resident fish, D.O. shall be greater than or equal to 5 mg/l. In no case shall D.O. above 17 mg/l be permitted. The concentration of total dissolved gas shall not exceed 110% of saturation at any point of sample collection.

WATER QUALITY CRITERIA

The water quality criteria, when used in combination with the water use designation, constitute the water quality standard for a particular water body. The water quality standards regulate human activities which result in alterations to waters within the jurisdiction of the state.

I. FRESH WATER USES v	TEMPERATURE	DISSOLVED INORGANIC SUBSTANCES
(A) Water Supply (i) drinking, culinary, and food processing	Shall not exceed 15°C.	Total Dissolved Solids (TDS) from all sources shall not exceed 500 mg/l. Neither chlorides nor sulfates shall exceed 200 mg/l.
(A) Water Supply (ii) agriculture, including irrigation and stock watering	Shall not exceed 30°C.	TDS shall not exceed 1,000 mg/l. Sodium absorption ratio less than 2.5, sodium percentage less than 60%, residual carbonate less than 1.25 mg/l, and boron less than 0.3 mg/l. (See Note 6).
(A) Water Supply (iii) aquaculture	Shall not exceed 20°C at any time. The following maximum temperature shall not be exceeded, where applicable: Migration routes: 15°C Spawning areas: 13°C Rearing Areas: 15°C Egg & Fry incubation: 13°C For all other waters, the weekly average temperature shall not exceed site specific requirements needed to preserve normal species diversity or to prevent appearance of nuisance organisms.	Total dissolved solids shall not exceed a maximum of 1,500 mg/l, including natural conditions. Increase in TDS shall not exceed one-third of the concentration of the natural condition of the body of water.
(A) Water Supply (iv) industrial	Shall not exceed 25°C.	No amounts above natural conditions which can cause corrosion, scaling, or process problems.
(B) Water Recreation (i) contact recreation	Shall not exceed 30°C.	Not applicable.
(B) Water Recreation (ii) secondary recreation	Not applicable.	Not applicable.
(C) Growth and Propagation of Fish, Shellfish, other Aquatic Life, and Wildlife	Shall not exceed 20°C at any time. The following maximum temperature shall not be exceeded, where applicable: Migration routes: 15°C Spawning areas: 13°C Rearing areas: 15°C Egg & Fry incubation: 13°C For all other waters, the weekly average temperature shall not exceed site specific requirements needed to preserve normal species diversity or to prevent appearance of nuisance organisms.	Total dissolved solids shall not exceed a maximum of 1,500 mg/l, including natural conditions. Increase in TDS shall not exceed one-third of the concentration of the natural condition of the body of water.

WATER QUALITY CRITERIA

The water quality criteria, when used in combination with the water use designation, constitute the water quality standard for a particular water body. The water quality standards regulate human activities which result in alterations to waters within the jurisdiction of the state.

I. FRESH WATER USES *	COLOR (See Note 11)	PETROLEUM HYDROCARBONS, OILS AND GREASE
(A) Water Supply (i) drinking, culinary, and food processing	Shall not exceed 75 color units where water supply is or will be treated. Shall not exceed 5 color units where water supply is not treated.	Shall not cause a visible sheen upon the surface of the water. Shall not exceed concentrations which individually or in combination impart odor or taste as determined by organoleptic tests.
(A) Water Supply (ii) agriculture, including irrigation and stock watering	Not applicable.	Shall not cause a visible sheen upon the surface of the water.
(A) Water Supply (iii) aquaculture	Shall not exceed 50 color units.	Shall not exceed 0.01 times the continuous flow 96 hour LC_{50} or, if not available, the static test 96 hour LC_{50} for the species involved. (See Notes 8 and 9).
(A) Water Supply (iv) industrial	Shall not cause detrimental effects on established water supply treatment levels.	Shall not make the water unfit or unsafe for the use.
(B) Water Recreation (i) contact recreation	Shall not exceed 15 color units.	Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils.
(B) Water Recreation (ii) secondary recreation	Shall not interfere with or make the water unfit or unsafe for the use.	Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shoreline. Surface waters shall be virtually free from floating oils.
(C) Growth and Propagation of Fish, Shellfish, other Aquatic Life, and Wildlife	Color or apparent color shall not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonally established norm for aquatic life. For all waters not having a seasonally established norm for aquatic life, color or apparent color shall not exceed 50 color units.	Total hydrocarbons in the water column shall not exceed 15 ug/l, or 0.01 of the lowest measured continuous flow 96 hour LC_{50} for life stages of species identified by the department as the most sensitive, biologically important species in a particular location, whichever concentration is less (See Notes 8 and 9). Total aromatic hydrocarbons in the water column shall not exceed 10 ug/l, or 0.01 of the lowest measured continuous flow 96 hour LC_{50} for life stages of species identified by the department as the most sensitive, biologically important species in a particular location, whichever concentration is less (See Notes 9 and 10). Concentrations of hydrocarbons, animal fats, or vegetable oils in the sediment shall not cause deleterious effects to aquatic life. Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oils.

WATER QUALITY CRITERIA

The water quality criteria, when used in combination with the water use designation, constitute the water quality standard for a particular water body. The water quality standards regulate human activities which result in alterations to waters within the jurisdiction of the state.

I FRESH WATER USES ▾	RESIDUES Floating Solids, Debris, Sludge, Deposits, Foam, Scum (not applicable to groundwater supplies)
(A) Water Supply (i) drinking, culinary, and food processing	Shall not alone or in combination with other substances or wastes make the water unfit or unsafe for use, cause a film, sheen, or discoloration on the surface of the water or adjoining shoreline, cause leaching of toxic or deleterious substances, or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.
(A) Water Supply (ii) agriculture, including irrigation and stock water ing	Shall not be present in quantities to cause soil plugging, reduced crop yield, or cause the water to be unfit or unsafe for the use.
(A) Water Supply (iii) aquaculture	Shall not alone or in combination with other substances or wastes cause the water to be unfit or unsafe for the use.
(A) Water Supply (iv) industrial	Shall not alone or in combination with other substances or wastes make the water unfit or unsafe for the use.
(B) Water Recreation (i) contact recreation	Shall not alone or in combination with other substances or wastes make the water unfit or unsafe for use, cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines, cause leaching of toxic or deleterious substances, or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.
(B) Water Recreation (ii) secondary recreation	Shall not alone or in combination with other substances or wastes make the water unfit or unsafe for use, cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines, cause leaching of toxic or deleterious substances, or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.
(C) Growth and Propagation of Fish, Shellfish, other Aquatic Life, and Wildlife	Shall not alone or in combination with other substances or wastes cause the water to be unfit or unsafe, or cause acute or chronic problem levels as determined by bioassay or other appropriate methods. Shall not alone or in combination with other substances cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines, or cause leaching of toxic or deleterious substances, or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.

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WATER QUALITY CRITERIA

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II. MARINE WATER USES *	pH (Variation of pH for waters naturally outside the specified range shall be toward the range)	TURBIDITY
(A) Water Supply (i) aquaculture	Shall not be less than 6.5 or greater than 8.5, and shall not vary more than 0.1 pH unit from natural conditions.	Shall not exceed 25 NTU.
(A) Water Supply (ii) seafood processing	Shall not be less than 6.0 or greater than 8.5. Shall not vary more than 0.5 pH unit from natural conditions.	Shall not interfere with disinfection.
(A) Water Supply (iii) industrial	Shall not be less than 5.0 or greater than 9.0.	Shall not cause detrimental effects on established levels of water supply treatment.
(B) Water Recreation (i) contact recreation	Shall not be less than 6.5 or greater than 8.5. If the natural pH condition is outside this range, substances shall not be added that cause any increase in buffering capacity of the water.	Shall not exceed 25 NTU.
(B) Water Recreation (ii) secondary recreation	Shall not be less than 5.0 or greater than 9.0.	Shall not exceed 25 NTU.
(C) Growth and Propagation of Fish, Shellfish, Aquatic Life and Wildlife	Shall not be less than 6.5 or greater than 8.5, and shall not vary more than 0.1 pH unit from natural conditions.	Shall not reduce the depth of the compensation point for photosynthetic activity by more than 10%. In addition, shall not reduce the maximum secchi disk depth by more than 10%.
(D) Harvesting for Consumption of Raw Mollusks or other Raw Aquatic Life	Shall not be less than 6.0 or greater than 8.5. Shall not vary more than 0.5 pH unit from natural conditions.	Same as (2)(C).

WATER QUALITY CRITERIA

The water quality criteria, when used in combination with the water use designation, constitute the water quality standard for a particular water body. The water quality standards regulate human activities which result in alterations to waters within the jurisdiction of the state.

II. MARINE WATER USES *	SEDIMENT	TOXICS AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES
(A) Water Supply (i) aquaculture	No imposed loads that will interfere with established water supply treatment levels.	Substances shall not individually or in combination exceed 0.01 times the lowest measured 96 hour LC_{50} (See Note 8) for life stages of species identified by the department as being the most sensitive, biologically important to the location, or exceed criteria cited in EPA, <u>Quality Criteria for Water</u> (See Note 5) or <u>Alaska Drinking Water Standards</u> (18 AAC 80), whichever concentration is less. Substances shall not be present or exceed concentrations which individually or in combination impart undesirable odor or taste to fish or other aquatic organisms as determined by either bioassay or organoleptic test (See Note 8).
(A) Water Supply (ii) seafood processing	Below normally detectable amounts.	Substances shall not exceed EPA, <u>Quality Criteria for Water</u> (See Note 5) as applicable to the substance.
(A) Water Supply (iii) industrial	No imposed loads that will interfere with established water supply treatment levels.	Substances shall not be present which pose hazards to worker contact.
(B) Water Recreation (i) contact recreation	No measurable increase in concentrations above natural conditions.	Substances shall not exceed EPA, <u>Quality Criteria for Water</u> (See Note 5) as applicable to constituent.
(B) Water Recreation (ii) secondary recreation	Shall not pose hazards to incidental human contact or cause interference with the use.	Substances shall not be present which pose hazards to incidental human contact.
(C) Growth and Propagation of Fish, Shellfish, Aquatic Life, and Wildlife	No measurable increase in concentration above natural conditions.	Substances shall not individually or in combination exceed 0.01 times the lowest measured 96 hour LC_{50} (See Note 8) for life stages of species identified by the department as being the most sensitive, biologically important to the location, or exceed criteria cited in EPA, <u>Quality Criteria for Water</u> (See Note 5) or <u>Alaska Drinking Water Standards</u> (18 AAC 80), whichever concentration is less. Substances shall not be present or exceed concentrations which individually or in combination impart undesirable odor or taste to fish or other aquatic organisms as determined by either bioassay or organoleptic test (See Note 5 and 8).
(D) Harvesting for Consumption of Raw Mollusks or other Raw Aquatic Life	Not applicable.	Substances shall not individually or in combination exceed 0.01 times the lowest measured 96 hour LC_{50} (See Note 8) for life stages of species identified by the department as being the most sensitive, biologically important to the location, or exceed criteria cited in EPA, <u>Quality Criteria for Water</u> (See Note 5) whichever concentration is less. Substances shall not be present or exceed concentrations which individually or in combination impart undesirable odor or taste to fish or other aquatic organisms as determined by either bioassay or organoleptic test (See Note 5 and 8).

WATER QUALITY CRITERIA

The water quality criteria, when used in combination with the water use designation, constitute the water quality standard for a particular water body. The water quality standards regulate human activities which result in alterations to waters within the jurisdiction of the state.

II MARINE WATER USES *	RADIOACTIVITY	TOTAL RESIDUAL CHLORINE
(A) Water Supply (i) aquaculture	Shall not exceed the concentrations specified in the <u>Alaska Drinking Water Standards</u> . Concentration factors for organisms involved shall not exceed maximum permissible limits for specific radioisotopes and unidentified mixtures as established in Title 10, <u>Code of Federal Regulations</u> , Part 20 (See Note 12) and <u>National Bureau of Standards</u> , Handbook 69 (See Note 13).	Concentrations shall not exceed 2.0 ug/l for salmonid fish, or 10.0 ug/l for other organisms (See Note 5).
(A) Water Supply (ii) seafood processing	Shall not exceed the concentrations specified in the <u>Alaska Drinking Water Standards</u> (See Note 5) and shall not exceed limits specified in Title 10, <u>Code of Federal Regulations</u> , Part 20 (See Note 12) or <u>National Bureau of Standards</u> , Handbook 69 (See Note 13).	Not applicable.
(A) Water Supply (iii) industrial	Same as (2)(A)(ii)	Not applicable.
(B) Water Recreation (i) contact recreation	Same as (2)(A)(ii).	Not applicable.
(B) Water Recreation (ii) secondary recreation	Same as (2)(A)(ii)	Not applicable.
(C) Growth and Propagation of Fish, Shellfish, Aquatic Life, and Wildlife	Same as (2)(A)(i)	Concentration shall not exceed 2.0 ug/l for salmonid fish or 10.0 ug/l for other organisms (See Note 6).
(D) Harvesting for Consumption of Raw Mollusks or other Raw Aquatic Life	Same as (2)(A)(i).	Shall not exceed 1 mg/l at any time

Notes:

1. Wherever cited in this chapter, fecal coliform bacteria will be determined by the membrane filter technique or most probable number procedure according to Standard Methods for the Examination of Water and Wastewater, 16th edition, 1985 (see (c)(1) of this section) or in accordance with other standards approved by the department and the U.S. Environmental Protection Agency (EPA).
2. Wherever cited in this chapter, dissolved oxygen (DO) concentrations in interstitial waters of gravel beds will be measured using the technique found in Variations in the Dissolved Oxygen Content of Intragravel Water in Four Spawning Streams of South-eastern Alaska, Special Scientific Report - Fisheries No. 402, February 1962, by William J. McNeil, available from the U.S. Department of the Interior. See Note 16.
3. Wherever cited in this chapter, fine sediments must be sampled by the method described in An Improved Technique for Freeze Sampling Streambed Sediments, USDA Forest Service Research Note PNW-281, October 1976, by William J. Walkotten, available from the USDA Forest Service Pacific Northwest Forest and Range Experiment Station, P.O. Box 909, Juneau, AK 99802, or by the technique found in Success of Pink Salmon Spawning Relative to Size of Spawning Bed Materials, Special Scientific Report Fisheries No. 469, January 1964, by William J. McNeil and W.H. Ahnell, pages 1 through 3, available from the U.S. Fish and Wildlife Service. See Note 16.
4. Wherever cited in this chapter, percent accumulation of fine sediments will be measured by the technique found in the Manual on Test Sieving Methods, Guidelines for Establishing Sieve Analysis Procedures, STP 447A, 1972 edition, available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103. See Note 16.
5. The term "EPA Quality Criteria for Water" includes Quality Criteria for Water, July 1976, U.S. Environmental Protection Agency, Washington, D.C. 20460, U.S. Government Printing Office: 1977 0-222-904, the Ambient Water Quality Criteria for the 64 toxic pollutants listed in the Federal Register, Vol. 45, No. 231, pg. 79318, November 1980, the Ambient Water Quality Criteria Document for 2, 3, 7, 8-tetrachlorodibenzopdioxin (TCDD) listed in the Federal Register, Vol. 49, No. 32, pg. 5831, February 1984, and the final ambient water quality criteria documents listed in the Federal Register, Vol. 50, No. 145, pg. 30784, July 1985. These documents may be seen at the central office of the department or may be purchased through the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.
6. The Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, Washington, D.C., April 1, 1968, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. See Note 16.

16. The cited document is on file in the lieutenant governor's office and may be seen at any department office.

(c) Water quality will be analyzed according to

(1) Standard Methods for the Examination of Water and Wastewater, 16th edition, 1985, published jointly by the American Public Health and American Water Works Associations, and the Water Pollution Control Federation (publisher: American Public Health Association, 1015 15th Street NW, Washington, D.C. 20005);

(2) Methods for Chemical Analysis of Water and Wastes, March 1979, Technical Report No. EPA 600-4-79-020, Environmental Monitoring and Support Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH 45268 (available from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161, Order No. PB 297686);

(3) Guidelines Establishing Test Procedures for the Analysis of Pollutants; Final Rule and Interim Final Rule and Proposed Rule, Federal Register Part VIII, EPA, Friday, October 26, 1984, 40 C.F.R. Part 136, Vol. 49, No. 209;

(4) Guidelines Establishing Test Procedures for the Analysis of Pollutants; Final Rule and Interim Final Rule and Proposed Rule; Corrections, Federal Register Part VI, EPA, Friday, January 4, 1985, 40 C.F.R. Part 136, pages 690 through 697;

(5) Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, July 1982 Technical Report No. EPA 600 14-82-057, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268;

(6) methods cited in (b) of this section; or

(7) other methods of analysis approved by the department and EPA. (In effect before 7/28/59; am 5/24/70, Register 34; am 8/28/71, Register 39; am 10/22/72, Register 44; am 8/12/73, Register 47; am 2/2/79, Register 69; am 4/23/79, Register 70; am 9/19/79, Register 71; am 12/19/82, Register 84; am 6/23/85, Register 94; am 1/7/87, Register 100)

Authority: AS 46.03.020
AS 46.03.070
AS 46.03.080

NOTE: The tables in 18 AAC 70.020(b) have been restructured to enhance readability. No substantive changes have been made.

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(3) in estuaries, where the fresh and marine water quality criteria differ within the same use class, the standard will be determined on the basis of salinity; however, the marine water quality criteria will apply for dissolved oxygen if the salinity is one part per thousand or greater and for fecal coliform bacteria if the salinity is 10 parts per thousand or greater. (In effect before 7/28/59; am 5/24/70, Register 34; am 8/28/71, Register 39; am 10/22/72, Register 44; am 8/12/73, Register 47; am 2/2/79, Register 69; am 1/7/87, Register 100)

Authority: AS 46.03.020(10)
AS 46.03.070
AS 46.03.080

18 AAC 70.032. MIXING ZONES. (a) In applying the water quality criteria set out in this chapter, the department will, upon application and in its discretion, prescribe in its permits or certifications a volume of dilution for an effluent or substance within a receiving water unless

(1) pollutants discharged could bioaccumulate; concentrate or persist in the environment; cause carcinogenic, mutagenic, or teratogenic effects; or otherwise present a risk to human health;

(2) there could be an adverse impact on anadromous fish spawning or rearing, or a barrier formed to migratory species; or

(3) there could be an environmental effect so adverse that a mixing zone is not appropriate.

(b) The water quality standards set out in this chapter may be exceeded within a mixing zone prescribed by the department. In determining whether a mixing zone is appropriate and the size of a mixing zone, the department will consider

(1) the physical, biological, and chemical characteristics of the receiving water, including volume and flow rate;

(2) the effects the discharge may have on the uses of the receiving water;

(3) the mixing characteristics of the receiving water; and

(4) the characteristics of the effluent, including volume, flow rate, and quality after treatment.

(c) In determining whether a mixing zone is appropriate and the size of a mixing zone, the department will ensure that other water uses are protected.

(d) A mixing zone must be as small as practicable and must be consistent with the provisions of this chapter.

(6) the potential transport of pollutants by biological, physical, and chemical processes.

(c) The department will, in its discretion, require an applicant to provide information that the department deems necessary to adequately assess (b)(1) - (b)(6) of this section. In all cases, the burden of proof for providing the required information is on the person seeking to establish a zone of deposit. (Eff. 3/30/84, Register 89; am 1/7/87, Register 100)

Authority: AS 46.03.020(10)
AS 46.03.070
AS 46.03.080
AS 46.03.100
AS 46.03.110

18 AAC 70.034. THERMAL DISCHARGES. Under section 316(a) of the Clean Water Act of 1977, if the owner or operator of a thermal discharge source, after opportunity for public hearing, can show to the department's satisfaction that application of the temperature criterion in 18 AAC 70.020 is more stringent than needed to assure the protection and propagation of diverse indigenous and anadromous populations of aquatic life in waters to which the discharge would occur, the department will, in its discretion, apply a new temperature criterion to the water body affected. The new criterion will assure the protection and propagation of diverse indigenous and anadromous populations of aquatic life, and other wildlife, in and on that water body, according to its protected use classes. (Eff. 2/2/79, Register 69; am 1/7/87, Register 100)

Authority: AS 46.03.020
AS 46.03.070
AS 46.03.080

18 AAC 70.040. NATURAL CONDITIONS. Repealed and consolidated into 18 AAC 70.010. 2/2/79.

18 AAC 70.050. CLASSIFICATION OF STATE WATERS. (a) Except as specified in (b) of this section, state water is protected for the following use classes:

- (1) fresh waters - Classes (1)(A), (1)(B), and (1)(C);
- (2) groundwaters - Classes (1)(A) and (2)(A)(iii);
- (3) marine waters - Classes (2)(A), (2)(B), (2)(C), and (2)(D).

(b) Specific water of the state is protected only for the designated use class shown, as follows:

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18 AAC 70.050

NAME	WATERSHED NUMBER*	LATITUDE LONGITUDE**	LOCATION	DESIGNATED USE CLASS	REACH OF WATER AFFECTED
Heine Creek	19030004	148°25'12"W 65°33'60"N	Near Livengood	(1) (A) (iv) (1) (C)	Headwaters of Heine Creek to Hess Creek Dam/reservoir diversion ditch
Isabell Creek	19030004	148°31'42"W 65°32'50"N	Near Livengood	(1) (A) (iv)	Headwaters of Isabell Creek to Hess Creek Dam road crossing
27 Isabell Creek	19030004	148°31'42"W 65°32'50"N	Near Livengood	(1) (A) (iv) (1) (C)	Hess Creek Dam road crossing to Hess Creek Dam/reservoir diversion ditch
Lillian Creek	19030004	148°34'23"W 65°30'40"N	Near Livengood	(1) (A) (iv)	Headwaters of Lillian Creek to its confluence with Livengood Creek
Lucille Creek	19030004	148°27'25"W 65°32'25"N	Near Livengood	(1) (A) (iv)	Headwaters of Lucille Creek to its confluence with Livengood Creek

NAME	WATERSHED NUMBER*	LATITUDE LONGITUDE**	LOCATION	DESIGNATED USE CLASS	REACH OF WATER AFFECTED
Ruth Creek	19030004	148°32'30"W 65°31'26"N	Near Livengood	(1) (A) (iv)	Headwaters of Ruth Creek to its confluence with Livengood Creek
Steel Creek	19030004	148°24'50"W 65°28'12"N	Near Livengood	(1) (A) (i) (1) (A) (iii) (1) (A) (iv) (1) (B) (ii) (1) (C)	Headwaters of Steel Creek to its confluence with the Tolovana River
Wonder Creek	19030004	148°27'21"W 65°33'33"N	Near Livengood	(1) (A) (iv) (1) (C)	Headwaters of Wonder Creek to Hess Creek Dam/reservoir diversion ditch

* Watershed numbers refer to watersheds established by the U.S. Department of Interior, Geological Survey "HYDROLOGIC UNIT MAP - 1974 STATE OF ALASKA" for sale by the U.S. Geological Survey, Fairbanks, AK 99701; Denver, CO 80225; or Reston, VA 22092. This document is on file in the lieutenant governor's office and may be seen at any department office.

** River latitudes and longitudes are set at the downstream end of the affected river reach, as determined from U.S. Department of Interior, Geological Survey, quadrangle maps or as assigned in "Water Resources Data for Alaska Water Year 1977" (U.S. Geological Survey Water Data Report AK-77-1). (In effect before 7/28/59, am 5/24/70, Register 34; am 8/28/71, Register 39; am 10/22/72, Register 44; am 8/12/73, Register 47; am 2/2/79, Register 69; am 9/22/84, Register 91; am 1/7/87, Register 100; am 11/30/89, Register 112)

Authority: AS 46.03.020(10)
AS 46.03.070
AS 46.03.080

18 AAC 70.058. RECLASSIFICATION CRITERIA. Repealed 1/7/87.

18 AAC 70.060. PERMITS. Repealed 10/22/72.

18 AAC 70.070. WATER QUALITY CRITERIA FOR WATERS OF THE STATE OF ALASKA. Repealed and consolidated into section 20(b). 10/22/72.

18 AAC 70.080. MINIMUM TREATMENT. Repealed and consolidated into 18 AAC 72. 2/2/79.

18 AAC 70.081. CERTIFICATE OF REASONABLE ASSURANCE. Repealed 8/21/78.

18 AAC 70.082. PUBLIC NOTICE OF APPLICATION. Repealed 8/21/78.

18 AAC 70.083. PUBLIC HEARING. Repealed 8/21/78.

18 AAC 70.084. NOTICE OF PUBLIC HEARING. Repealed 8/21/78.

18 AAC 70.085. ACTION UPON APPLICATION. Repealed 8/21/78.

18 AAC 70.086. ENFORCEMENT DISCRETION. In determining whether to initiate enforcement action on a water quality violation, the department will consider whether the activity in question was conducted in compliance with permit conditions established in accordance with AS 46.03.100 or 46.03.110(e), and with 18 AAC 15; engineering plans approved in accordance with AS 46.03.720; or best management practices adopted by the department. This section is intended to confirm the department's enforcement discretion, and does not create a reviewable decision. (Eff. 2/2/79, Register 69; am 1/7/87, Register 100)

Authority: AS 46.03.020

18 AAC 70.090. IMPLEMENTATION AND ENFORCEMENT PLAN. Consolidated in 18 AAC 72. 2/29/79.

18 AAC 70.100. PENALTIES. Repealed 8/21/78.

(12) "contact recreation" means activities in which there is direct and intimate contact with water; examples include wading, swimming, diving, water skiing, and any intimate contact with water directly related to shoreline activities;

(13) "criterion" means a set concentration or limit of a constituent that, when not exceeded, will protect an organism, a population of organisms, a community or organisms, or a prescribed water use with a reasonable degree of safety; in some cases, a criterion might be a narrative statement instead of a numerical concentration or limit;

(14) "department" means the Alaska Department of Environmental Conservation;

(15) "dissolved oxygen" means the concentration of oxygen in water as determined either by the Winkler (iodometric) method and its modifications or by the membrane electrode method;

(16) "effluent" means the segment of a wastewater stream that follows the final step in a treatment process and precedes discharge of the wastewater stream to the receiving environment;

(17) "fecal coliform bacteria" means those bacteria that can ferment lactose at $44.5^{\circ} \pm 0.2^{\circ}\text{C}$ to produce gas in a multiple tube procedure; "fecal coliform bacteria" also means all bacteria that produce blue colonies within $24 \pm$ hours of incubation at $44.5^{\circ} \pm 0.2^{\circ}\text{C}$ in an M-FC broth medium;

(18) "fish" means any of the group of cold-blooded vertebrates that live in water, and have permanent gills for breathing and fins for locomotion;

(19) "grain size accumulation graph" means a plot of sediment-sieving data showing logarithm of grain size in millimeters on the horizontal axis and percent accumulation by weight (linear scale) on the vertical axis;

(20) "groundwater" means water in the zone of saturation, which is the zone below the water table, where all interstices are filled with water;

(21) "industrial use" means use of a water supply for a manufacturing or production enterprise except food processing, and includes mining, placer mining, energy production, or development;

(22) "lake" means an inland water body of substantial size, occupying a basin or hollow in the earth's surface, which may or may not have a current or single direction of flow;

(34) "pollution" means the contamination or altering of state land or water in a manner that creates a nuisance or makes land or water unclean, noxious, impure, or unfit so that it is actually or potentially harmful, detrimental, or injurious to

(A) public health, safety, or welfare;

(B) domestic, commercial, industrial or recreational use; or

(C) livestock, wildlife, or aquatic life;

(35) "residues" means floating solids, debris, sludge deposits, foam, scum, or any other material or substance remaining in a water body as a result of direct or nearby human activity;

(36) "secondary recreation" means recreation activities in which water use is incidental, accidental, or sensory; it includes fishing, boating, camping, hunting, hiking, and vacationing;

(37) "sediment" means solid material of organic or mineral origin that is transported by, suspended in, or deposited from water; it includes chemical and biochemical precipitates and organic material such as humus;

(38) "sheen" means an iridescent appearance on the water surface;

(39) "sodium adsorption ratio (SAR)" means the estimated degree to which sodium from a given water will be adsorbed in soil, as proposed by the U.S. Salinity Laboratory, U.S. Department of Agriculture, "Handbook 60"; it is expressed as the quotient of the sodium ion concentration and the square root of half the sum of the calcium and magnesium ion concentrations:

$$\frac{(Na^{++})}{\sqrt{\frac{(Ca^{++}) + (Mg^{++})}{2}}}$$

(40) "spawning" means the process of producing, emitting, or depositing eggs, sperm, seed, germ, larvae, young, or juveniles, especially in large numbers, by aquatic life;

(45) "turbidity" means an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a water sample; turbidity in water is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms;

(46) "water" means lakes, bays, sounds, ponds, impounding reservoirs, springs, wells, rivers, streams, creeks, estuaries, marshes, inlets, straits, passages, canals, the Pacific Ocean, Gulf of Alaska, Bering Sea and Arctic Ocean, in the state's territorial limits, and all other bodies of surface or underground water that are wholly or partially under state jurisdiction; "water" does not include ponds or lagoons or parts of wastewater treatment systems that are lined or constructed so that seepage into the ground is not allowed;

(47) "water recreation" means contact recreation or secondary recreation, as defined in this section;

(48) "water supply" means any of the waters of the state which are designated to be protected for fresh water or marine water uses, including waters used for drinking, culinary, food processing, agricultural, aquacultural, seafood processing, and industrial purposes; "water supply" does not necessarily mean that a water body that is protected as a supply for the uses listed in this paragraph is safe to drink in its natural state; and

(49) "wildlife" means all species of mammals, birds, reptiles, and amphibians. (In effect before 7/28/59; am 5/24/70, Register 34; am 8/28/71, Register 39; am 10/22/72, Register 44; am 8/12/73, Register 47; am 2/2/79, Register 69, am 4/23/79, Register 70; am 9/19/79, Register 71; am 6/23/85, Register 94; am 1/7/87, Register 100)

Authority: AS 46.03.010
AS 46.03.020
AS 46.03.070
AS 46.03.080
AS 46.03.100
AS 46.03.110

Editor's Note: The address of the central office of the Department of Environmental Conservation referred to in 18 AAC 70.110(5) is P.O. Box O, Juneau, AK 99811-1800.

NOTE: The official version of this document is printed in the Alaska Administrative Code, published by the Michie Company. If any discrepancies are found between this version and the published version, the published version will apply unless the discrepancy is an obvious error in the published version. The tables at 18 AAC 70.020 and at 18 AAC 70.050 have been restructured to enhance readability; no substantive changes have been made.

TAB

Appendix G

APPENDIX G
RESUMES
OF
FIELD TEAM MEMBERS

CHRISTOPHER L. VAIS

project management
hazardous materials management
subsurface contamination
investigation
litigation support

EDUCATION

California State University, Hayward: B.S. Biological Science

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Senior Project Engineer, 1984-date
U.S. Environmental Protection Agency, Environmental Scientist/Senior On-Scene
Coordinator, 1974-1984
U.S. Coast Guard, Commissioned Officer, 1971-1974

REPRESENTATIVE EXPERIENCE

Mr. Vais' technical expertise includes the management, treatment, and disposal of oil and hazardous materials, particularly as it applies to the clean-up of uncontrolled hazardous waste sites, hazardous materials spills, and oil spills. He is also experienced in the decommissioning of PCB electrical equipment. Mr. Vais has a strong contract management background, having developed and managed a number of waste cleanup and technical support contracts.

Specific project experience at Woodward-Clyde Consultants includes:

- Project Manager for the Confirmation Study, Remedial Investigation, and Feasibility Study for Hamilton AFB. The work was performed for the Omaha District Corps of Engineers over a 3-year period pursuant to the Defense Environmental Restoration Act (DERA). Field work included the investigation of the base landfill, incinerator sites, underground storage tanks, a low-level radiological disposal site, and the base industrial plant. A long-term groundwater monitoring program was also conducted. A Confirmation Study Report, Remedial Investigation Report, Feasibility Study Report and Risk Assessment were prepared.
- Project Manager for the remediation of two abandoned printed circuit board manufacturing facilities in Stockton, CA. The client has contracted with Woodward-Clyde to conduct the remedial investigations of both facilities, and to prepare feasibility studies and remedial action plans for both sites. Woodward-Clyde will also provide management consultation during clean up. Both facilities are California Superfund sites.
- Project Manager for the RCRA Facility Investigation of a wood treatment facility. Contaminants include heavy metals and pentachlorophenol. Field work includes onsite and offsite investigation of surface and subsurface soil and groundwater contamination. Additional activities will include preparation of a feasibility study, engineering plans and specifications, and construction management oversight.
- Project Manager for a project which provides technical support to a major San Francisco law firm. Woodward-Clyde has been retained to assist in the defense of the law firm's client, a defendant in a groundwater contamination lawsuit. Responsibilities include data review, background investigation, installation, and sampling of monitoring wells, geophysical surveys and soil sampling.

CHRISTOPHER L. VAIS

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- Project Manager for a number of small technical litigation support projects for two major San Francisco law firms. Cases, for which support is being provided, are both civil and criminal.
- Project Manager for a project to prepare the design basis and the authority to construct permit application for a flare tower to be installed at a railcar cleaning facility.
- Project Manager for an EPA REM II Contract project reviewing documents submitted to the EPA by the Department of Defense under the Installation Restoration Program (IRP).
- Project Manager for McClellan AFB REM II Contract project for EPA Region 9. The project provides technical support and assists the EPA in evaluating the Air Force's cleanup of the site.
- Assistant Project Manager on a project to assess the extent of PCB contamination resulting from improper disposal of PCB-contaminated natural gas condensate. The client, a natural gas pipeline company, has contracted Woodward-Clyde Consultants to quantify the degree of contamination and to develop remedial measures to clean up sites found to be contaminated.
- Principal Investigator on a project for a large oil company, to examine a former tank farm for the presence of hazardous materials. The project requires development of sampling plans, field sampling and analysis, and design of a remedial plan utilizing on-site treatment and recycling, along with excavation and removal.

As the Senior On-Scene Coordinator for EPA Region 9, Mr. Vais was responsible for the coordination of the region's response to oil and hazardous materials releases as well as other environmental emergencies. He directed or participated in the assessment of a diversity of sites including abandoned drum storage sites, chemical and pesticide dumps, a pesticide contaminated airfield, underground tank leaks, PCB electrical equipment storage sites, and landfills. Specific experience includes:

- Managed or participated in some of EPA Region 9's responses to major oil and hazardous materials spills. Principal among these were: T/V Puerto Rican, Lake Wishon, CA and Osito Canyon, CA, oil spills; and hazardous materials spills at Santa Fe Springs, CA, Coppermine, AZ, and in the Pacific Islands. The Pacific Islands project was developed to remove all non-DOD hazardous materials from Guam, Saipan and the islands of the U.S. Trust Territory of the Pacific Islands. After a thorough preliminary assessment and 10 months of careful planning and logistics, Mr. Vais and another EPA On-Scene Coordinator led two teams of six EPA, USCG, and contractor personnel on a 10-week expedition to the Islands to complete the removal. Working independently of each other, both teams succeeded in removing, treating, or destroying all the material originally proposed for removal plus considerable additional material which appeared once the teams arrived on island. Despite unfavorable working conditions and unforeseen logistical problems, the removal phase was completed on time and under budget.
- Trained EPA federal, state, and local response personnel, managed budget, reviewed contingency plans, coordinated state and local response agencies, and developed knowledge of environmental legislation and regulation.

CHRISTOPHER L. VAIS

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AWARDS

EPA Bronze Medal for Commendable Service
EPA Office of Emergency and Remedial Response, Directors Award
Letter of Commendation for Actions at General Disposal Site

PUBLICATIONS

Superfund removals in remote areas of the world: Pacific Island immediate removal project (co-author). Presented at Management of Uncontrolled Hazardous Waste Sites Conference, Washington D.C., 1984.

Heat-stress monitoring at uncontrolled hazardous waste sites (co-author). Presented at Management of Uncontrolled Hazardous Waste Sites Conference, Washington D.C., 1984.

Regulatory encounters at Santa Fe Springs, legal considerations for hazardous waste removal. Presented at National Hazardous Materials Spill Conference, 1984.

FREDERICK WEHREBERG, JR.

hazardous materials
investigation/management
water quality

EDUCATION

U.S. Coast Guard: Training in hazardous chemicals and marine systems.

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Staff Scientist, 1985-date

United States Coast Guard: Marine Safety Office, Hazardous Chemical Response Team, 1977-1985

REPRESENTATIVE EXPERIENCE

Mr. Wehrenberg is experienced in hazardous materials inspection, storage, and cleanup; project coordination; and training of personnel in pollution control. He has coordinated operations with the EPA, and is thoroughly familiar with federal regulations on water pollution. Specific project experience includes:

- Site Safety Officer and Chemist for a PCB investigation project for a natural gas facility in New Mexico. Mr. Wehrenberg supervised site safety, managed drilling operations, and selected, tested, and classified samples.
- Training Officer, U.S. Coast Guard Haz-Chem Response Team. Trained and supervised personnel in pollution control, inspection of facilities, and enforcement of federal laws. Coordinated operations with the EPA, cleanup contractors, and other agencies.
- Pollution Investigator, U.S. Coast Guard. Enforced federal water pollution regulations, investigated hazardous material spills, and supervised cleanup operations.
- Installation and sampling of monitoring wells and investigation of soil and groundwater contamination for an electronics plating facility.
- Supervision of Subcontractor (in EPA Level B Protection) during sampling of PCB-contaminated electrical transformers. Coordinated efforts with the U.S. Navy and the Army Corps of Engineers to deenergize and sample over 200 electrical transformers at a deserted air force base.
- Sampling of several monitoring wells within a landfill to monitor groundwater contamination over an entire year.
- Location of buried radiological waste cylinder using a Geiger counter, at a deserted air force base.
- Instructor for a short course on computer graphics at the National Meeting of the Association of Engineering Geologists.

WEHREBERG 3-87/23

STACEY BROWN

analytical chemistry
data base management

EDUCATION

National University: B.S., Computer Science, 1987
University of California, San Diego: B.A., Chemistry, 1983

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Staff Scientist, 1987-date
Aerojet Techsystems, Environmental Analysis Laboratory, Chemist, 1987
Aerojet Strategic Propulsion Company, Research & Development Laboratory, Associate Chemist, 1984-1987

REPRESENTATIVE EXPERIENCE

Mr. Brown serves as a chemist and data base specialist on the staff of Woodward-Clyde Consultants. His expertise is quality control and quality assurance for sample analysis data. While at WCC, he has been responsible for quality control, accuracy of data gathering, and testing for a variety of projects, including groundwater and soil sampling.

Mr. Brown's project experience includes:

- Chemistry Task Leader/Data Base manager for a project in Alaska for the Air Force. Responsible for checking quality control and quality assurance on laboratory sample analysis data. Implemented a computer data base system for sample analysis data. Field sample coordinator.
- Casmalia data base person responsible for quality control and quality assurance for laboratory sample analysis data. Responsible for water quality data sections in quarterly reports. Task leader for investigation of groundwater site anomalies.
- Chemist responsible for quality control/quality assurance for soil and water data for Tracy project. Responsible for data analysis sections for soil and water samples.
- Chemical Analyst for quality assurance/quality control laboratory sample analysis data on Western Farms project.
- Chemist in Environmental Analysis Laboratory for Aerojet Techsystems. Analyzed water and waste samples by Ion chromatography using a Dionex instrument. Section leader for the wet chemistry laboratory. Quality control inspector for production manufacturing department involving particle analysis determination.
- Associate Chemist in Research & Development Laboratory for Aerojet Strategic Propulsion Company. Production quality control supervisor responsible for quality control and production line audits.

ROBIN K. SPENCER

environmental sciences
hazardous materials management

EDUCATION

University of California, Berkeley: B.A., Geography, 1980

University of California, Davis: Certificate, Hazardous Materials Management, 1987

Post-graduate studies in business administration, geology, and technical writing

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Staff Scientist, 1985-date

University of California, Lawrence Berkeley Laboratory, Research Associate, 1979-1985

REPRESENTATIVE EXPERIENCE

Ms. Spencer is experienced in environmental assessment, with responsibilities including project coordination, writing and review of technical reports, financial administration, and field sampling and quality assurance procedures. Specific projects include the following:

- Assistant Site Manager, EPA Superfund project in Tacoma, Washington. Ms. Spencer reviewed and authored technical reports; served as quality assurance officer for the sampling effort; and was responsible for financial and logistical administration.
- Project Coordinator, EPA Superfund project in Oahu, Hawaii. Ms. Spencer coordinated financial administration and wrote technical reports.
- In-house coordinator, author and reviewer of sampling plans, and administrative assistant, EPA Superfund project, Region 9. Ms. Spencer interfaced with the National Program Management Office (NPMO) for REM-II on financial and administrative matters: policy, budgets, contract lab program, and subcontracting.

Ms. Spencer's responsibilities at Lawrence Berkeley Laboratory included:

- Organization and conduct of international literature searches in the fields of nuclear waste isolation, geothermal energy, and indoor air quality.
- Editing and production of major scientific reports, including a review work on indoor air pollutants. Collected and analyzed information; created two data bases with final project results.
- Management of senior staff scientist's \$1.4 million research budget. Produced, documented, and evaluated computer-generated financial statements.

PUBLICATIONS

Indoor air quality control techniques: A critical review (with W. Fisk, D.T. Grimsrud, F.J. Offerman, B. Pedersen, and R. Sextro). Lawrence Berkeley Laboratory, LBL-16493, 1984.

Listing of scientific data on the Baca Geothermal Field (with C.F. Tsang). Lawrence Berkeley Laboratory, LBL-17675, 1984.

Thermal impact of waste emplacement and surface cooling associated with geological disposal of nuclear waste (with J.S.Y. Wang, D.C. Mangold, and C.F. Tsang). Lawrence Berkeley Laboratory, NUREG/CR-2910, LBL-13341, 1981.

KEITH F. MOBLEY

arctic engineering
foundation engineering
civil engineering

EDUCATION

Montana State University: B.S., Civil Engineering, 1976
San Diego State University: graduate coursework in soil mechanics
and hydraulics, 1976-1977
Dartmouth: M.S., Civil Engineering, 1988

REGISTRATION

Professional Civil Engineer: Alaska, 1981; California, 1979

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Staff to Project Engineer, 1981-date
Ted Forsi and Associates, Anchorage, Alaska, Civil Engineer, 1980-1981
San Dieguito Engineering, Rancho Santa Fe, California, Geotechnical Engineer,
1977-1980

REPRESENTATIVE EXPERIENCE

Offshore Geotechnical Work, Beaufort Sea: Mr. Mobley's work has included supervision of drilling and sampling through the sea ice for gravel island foundation designs and design and stability of a seawater intake facility. These projects were at remote sites requiring skillful logistical planning and support. Both frozen and thawed samples were obtained, tested, and prepared for in-situ condition shipment to laboratory facilities. He also supervised construction observation and fill testing of man-made islands up to six miles offshore, connected by ice roads. Fill materials, which had to be placed in layers and then compacted, originated from upland sources. The work involved hands-on experience with field construction observations and tests, tests in a field laboratory, and installation and reading of field instrumentation.

Onshore Geotechnical Investigations: As an Engineer working in California, his projects included landslide and settlement analysis, site stability and geologic reconnaissance, grading and compaction certification, foundation design, exploratory borings and seepage analysis.

Alaskan onshore work has included several pile installation projects, one which included a state-of-the-art design for heavy pile loads at a North Slope coastal site. The work included participation in the original design and review of the contractor's alternative construction proposal. As the Project Engineer, he provided the technical input and made decisions regarding all field design changes and pile load test certification. He has conducted similar investigations for foundation design and site analysis for two commercial developments in Homer and two developments in Anchor River. He also performed a soils investigation and gravel source search for a proposed industrial park and an eight-mile extension of the Point MacKenzie road system.

Hydrology: For the Chakachamna and Bradley Lake Hydroelectric Projects, Mr. Mobley performed hydraulic and river flow studies including

KEITH F. MOBLEY

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instrumentation and flow measurements. Instrumentation installation required scuba diving and rock climbing techniques in extremely difficult field conditions. He also assisted in the field interpretation of data collected. On the Ninglik River in western Alaska, he performed bathymetric surveys utilizing electronic positioning equipment and a portable bathymeter. This project was assisted by local residents interested in the project.

On the Trans-Alaska Pipeline Project, operations phase, he worked closely with Alyeska's engineering personnel as a field engineer during pipeline repair work in an unstable permafrost area at Atigun Pass. He was responsible for instrumentation, installation and monitoring, and for design and construction of surface drainage, and also assisted in preparation of summary documents for year's construction and data acquisition. Instrumentation included inclinometers/borehole extensometers, standpipe piezometers and thermistor strings. Mr. Mobley obtained much hands-on experience with installation of geotechnical instruments and developed new installation methods to help the instruments withstand the rigors of construction activities and the arctic environment.

Geophysics: For the Susitna Hydroelectric project he worked as a field engineer on a seismic refraction investigation. Work included setting explosive charges, preparing sensors and operating the data collection instruments. He also performed field interpretation of obtained data on a regular basis for the client representative on site. For a major waterline project, he developed and executed a seismic survey to define bedrock interfaces and cross-slope profiles. Analysis of the data was used for stability analysis and cost estimating.

Civil Design: Civil engineering experience in Alaska and California included street and utility design and specifications, design and specifications for expansion of a water utility system including a 1-MG tank reservoir, septic system design for individual homes and commercial developments. While working in San Diego, Mr. Mobley was involved with subdivision designs, including street and arterial road layout, cut and fill calculations drainage and utility layout.

In Alaska he completed a conceptual design and cost estimate for the upland facilities of a proposed fishing fleet harbor in Atka. Included was a review of potential site locations, an onsite survey of the foundation conditions, existing infrastructure and material borrow sources. The design was presented in a report which included text photos and drawings of recommended alternatives. Also completed was a street and utility design and specifications for a major street in the community of Soldotna. Work included quantity calculations, drainage design, utility locations, survey coordination, drafting coordination and preparation of the specification document.

AFFILIATIONS

American Society of Civil Engineers/Member
Canadian Geotechnical Society/Member

PUBLICATION

Special Pile Foundations for a Coastal Permafrost Site (with H.P. Thomas)
ASCE Fourth International Cold Regions Engineering Specialty Conference, 1986

Woodward-Clyde Consultants**KELLY D. SUSEWIND**

hazardous waste investigation
geotechnical engineering
construction monitoring/
inspection

EDUCATION

Washington State University: B.S., Geological Engineering, 1984
Grays Harbor College: A.S., Engineering, 1982

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Anchorage, Alaska, Senior Staff Engineer,
1985-date
Geo Engineers, Bellevue, Washington, Field Engineer, 1985

REPRESENTATIVE EXPERIENCE

Mr. Susewind has been involved with hazardous waste investigations in Alaska, Washington and Texas. Specific responsibilities and projects have included:

- Field supervisor for a drilling and sampling operation conducted at several remote Alaskan military sites. Responsibilities included supervision of a crew of seven, mobilization of equipment, supervision of drilling operations including monitoring well installation and development, soils logging, soil and water sampling, and assisting in the preparation of the final report.
- Member of a sampling and analytical team that characterized the constituents present throughout a ballast water treatment facility. Contributions to the project included: extensive sampling throughout the system, design and fabrication of a specialized sampling device, reduction and analysis of a major portion of the data collected, and assisting in writing the final report. Mr. Susewind also conducted an in-tank physical inspection in which he was responsible for devising a sampling scheme, designing and fabricating a sampling device and technique, sampling the tank, running appropriate laboratory tests and reporting the results to the client.
- Field investigator and co-decon manager for an extensive drilling and sampling operation conducted at an abandoned hazardous waste dump site in Texas. His responsibilities included: mobilization of equipment, logging boreholes, devising proper sampling protocol, and soils sampling. As decon manager he was responsible for proper decontamination of all drilling and sampling equipment.
- Assistant for soil-gas investigations in which his responsibilities have included mobilization of equipment, installation of sampling probes, and evacuation and sampling of the probes.
- Completed hazardous waste training, level "B" and "C."

KELLY D. SUSEWIND

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Mr. Susewind also has experience in more typical engineering applications including: soils logging of test pits and boreholes and geophysical logging of boreholes; performing calculations for bearing capacity, settlement, and time of settlement for building foundations; doing slope stability calculations using state of the art computer programs; performing various hydrologic calculations; providing fill control and inspection; and monitoring the installation of auger-cast piles.

HONORS

Member of the Top Ten graduates, Weatherwax High School, 1979
Member of the Top Ten graduates, Grays Harbor College, 1982
Selected The Outstanding Senior in Geological Engineering, WSU, 1984
Recipient of The Bishop-Fleet Foundation Scholarship, 1982-1984
Monetary award for academic excellence.

RESUME

JAMES A. MUNTER

EXPERIENCE

- 5/86 to present - Senior Hydrogeologist. Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, Eagle River, Alaska. Major duties were conducting and reporting on ground-water investigations. Established scope and objectives of section ground-water investigations, supervised three hydrogeologists, and coordinated data collection activities with other agencies. Provided hydrogeologic review and advice to other agencies.
- 5/82 to 5/86 - Project Hydrogeologist. Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, Eagle River, Alaska. Conducted and reported on ground-water supply evaluations including major study areas of Eagle River, Potter Marsh, Anchorage Hillside, and Fairbanks Uplands. Planned and supervised two air-rotary drilling contracts for observation wells, developed digital water-level recording and data processing capabilities, applied a three-dimensional ground-water flow model to the Eagle River confined aquifer system, and gave presentations on project results.
- 3/82 to 4/82 - Geologist. R&M Consultants, Anchorage, Alaska. Logged soil borings at Prudhoe Bay, Alaska.
- 9/79 to 9/81 - Project Hydrogeologist. Iowa Geological Survey, Iowa City, Iowa. Directed and conducted parts of two regional hydrogeologic investigations in Iowa, including synthesis of surface and subsurface data, direction of a rotary drilling rig, geophysical well logging, conduction of pumping tests, and supervision and training of support personnel. Technical assistance and expert testimony were provided to other state agencies regarding ground-water contamination problems and controversies involving allocations to municipal, rural water, irrigation, and domestic supply systems.
- 1/80 to 5/81 - Adjunct Instructor. University of Iowa, Iowa City, Iowa. Developed and taught a hydrogeology course for seniors and graduate students, and directed independent studies.
- 1/78 to 8/79 - Research Assistant. University of Wisconsin, Madison, Wisconsin. Finite-difference ground-water flow models were used to simulate flow systems at three lake/aquifer systems in Wisconsin. Cross-sectional, three-dimensional, and transient models were used.
- 9/77 to 12/77 - Teaching Assistant - Introductory Geology
- 6/75 to 9/75 - Field Assistant EME, Inc., Duluth, Minnesota. Assisted magnetic, induced polarization, electromagnetic and shallow seismic refraction surveys in Minnesota, Wisconsin, and Michigan for mineral exploration programs.

EDUCATION

- M.S. Degree, Geology, 1979. University of Wisconsin - Madison, Wisconsin.
Emphasis on Hydrogeology.
- B.S. Degree, Geology and Math, 1977. University of Minnesota - Duluth,
Minnesota. Outstanding Senior, Geology Department, Magna cum laude (GPA
3.6/4.0).
- Duluth East High School, Duluth, Minnesota. Graduated 26/5/12, 1973.

REFERENCES

- | | |
|--|--|
| <p>Larry L. Dearborn
E.C. Jordan Company
P.O. Box 7050
Portland, Maine 04112
(207) 775-5401
[Senior Geohydrologist,
DGGs, Alaska, 1/81-4/86]</p> | <p>Dr. William E. Long
Alaska Division of Geological &
Geophysical Surveys (DGGs)
P.O. Box 772116
Eagle River, Alaska 99577
(907) 696-0070</p> |
| <p>Dr. George A. Hallberg
Geological Survey Bureau
Iowa Department of Natural Resources
Iowa City, Iowa 52242
(319) 335-1575</p> | <p>Dr. Mary P. Anderson
Department of Geology and Geophysics
1215 W. Dayton Street
Madison, Wisconsin 53706
(608) 262-2396</p> |
- REVIEWED PUBLICATIONS
- Munter, J.A., and Maynard, D.L., 1987, Extent of ground-water contamination in Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 87-16 17p.
- Munter, J.A., 1986, Ground-water contamination at Peters Creek, Municipality of Anchorage, Alaska. Ground-water occurrence and movement. Alaska Division of Geological and Geophysical Surveys Report of Investigations 86-24, 12 p.
- _____, 1986, Evidence of ground-water recharge through frozen soils at Anchorage, Alaska: in Kane, D.L., editor, Cold Regions Hydrology Symposium, Proceedings, American Water Resources Association, Bethesda, Maryland, p. 245-252.
- Munter, J.A., and Prokosch, G.J., 1985, Recognition and resolution of Eagle River's ground-water conflicts: Roles of data and water rights: in Dwight, L.P., Chairman, Resolving Alaska's water resources conflicts. Proceedings, Alaska Section, American Water Resources Association, Institute of Water Resources/Engineering Experiment Station, University of Alaska-Fairbanks, Report IWR-108, p. 167-175.
- Munter, J.A., 1984, Ground-water occurrence in Eagle River, Alaska: Alaska Division of Geological and Geophysical Surveys, Report of Investigation 84-21, 15 p.
- Munter, J.A., and Dearborn, L.L., 1984, Evaluation of a shallow sand-and-gravel aquifer at Eagle River, Alaska, in Short Notes on Alaskan Geology, 1982-83: Alaska Division of Geological and Geophysical Surveys Professional Report 86, p. 13-18.
- Munter, J.A., Ludvigson, G.A., and Bunker, B.J., 1983, Hydrogeology and stratigraphy of the Dakota aquifer in Iowa: Iowa Geological Survey Water Supply Bulletin No. 13, 55 p.
- Munter, J.A., and Anderson, M.P., 1981, The use of ground-water flow models for estimating lake seepage rates: Ground Water V. 19, No. 6, p. 608-616.
- Anderson, M.P., and Munter, J.A., 1981, Seasonal reversals of ground-water flow around lakes and the relevance to stagnation points and lake budgets: Water Resources Research, v. 17, no. 4, p. 1139-1150.
- Munter, J.A., 1980, Evaluation of the extent of hazardous waste contamination in the Charles City area: Iowa Geological Survey Contract Report, July 30, 1980, 74 p.

ABSTRACTS AND BRIEF OR INFORMAL REPORTS

- Munter, J.A., and Maynard, D.L., 1987, Data from Alaska inventory of contaminated aquifers: Alaska Division of Geological and Geophysical Surveys Public-Data File 87-23, unpaginated.
- Munter, J.A., 1987, Review of a consultant's report on septic system contamination at Anchorage, Alaska, with interpretations of data: Alaska Division of Geological and Geophysical Surveys Public-Data File 87-14, 15 p.
- _____, 1987, Availability of ground-water quality data in Alaska: Alaska Division of Geological and Geophysical Surveys, Public-Data File 87-7, 87 p.
- _____, 1986, Results of an aquifer test at Peters Creek, Municipality of Anchorage, Alaska: Alaska Division of Geological and Geophysical Surveys, Public-Data File 86-77, 7 p.
- _____, 1986, Recent well failures in southwest Eagle River, Alaska: Alaska Division of Geological and Geophysical Surveys, Public-Data File 86-24, 6 p.
- _____, 1986, Evaluation of aquifers near Alpine Woods subdivision, south Anchorage, Alaska: Alaska Division of Geological and Geophysical Surveys, Public-Data File 86-11, 13 p.
- _____, 1985, Water-level declines in wells in south Anchorage, a presentation to the Alaska Water Board: Alaska Division of Geological and Geophysical Surveys, Public-Data File 85-35, 5 p.
- Dearborn, L.L., and Munter, J.A., 1985, Water-level declines in wells tapping lower Hillside aquifers, Anchorage, Alaska: Alaska Division of Geological and Geophysical Surveys, Public-Data File 85-13, 12 p.
- Munter, J.A., 1984, Status of hydrogeologic work near Potter Marsh with suggestions for future work: Alaska Division of Geological and Geophysical Surveys, Individual Report, February 15, 1984, 7 p.
- Anderson, Mary P., and Munter, James A., 1984, Comment on "The interaction of lakes with variably saturated porous media" by Thomas C. Winter: Water Resources Research v. 20, no. 8, p. 1164-1165.
- Munter, J.A., 1981, A hazardous-waste landfill in Charles City, Iowa: Iowa Geology, no. 6, p. 5-8.
- Munter, J.A., and Hallberg, G.R., with J. Wiegand and M. Smith, 1981, The Dakota aquifer study and the development of water allocation policies in northwest Iowa: Iowa Geology, no. 6, p. 16-17.
- Munter, J.A., 1981, Results of an aquifer analysis in northeastern Carroll County, Iowa: Iowa Geological Survey report to the Iowa Natural Resources Council, July 8, 1981, 30 p.
- _____, 1981, The Dakota aquifer in Iowa as part of several regional ground-water flow systems: N-C Section CSA, Abstracts with Programs, v. 13, no. 6, March, 1981, p. 310.
- Hallberg, G.A., and Munter, J.A., 1980, Report of investigations on the occurrence of gasoline in the soil and in the ground water in Davenport, Iowa: Iowa Geological Survey, December 30, 1980, unpaginated.
- Munter, J.A., 1980, Evaluation of water quality monitoring at Great Plains Beef Scheidle site: Iowa Geological Survey Contract Report, July 15, 1980, 13 p.
- _____, 1979, Groundwater modeling of three lake/aquifer systems in Wisconsin: M.S. Thesis, University of Wisconsin, Madison, Wisconsin, 100 p.
- Munter, J.A., and Anderson, M.P., 1979, Comparison between two- and three-dimensional models of a ground-water lake system in Wisconsin: GSA Annual Meeting, Abstracts with Programs, v. 11, no. 7, August 1979, p. 485.
- _____, 1979, Estimating ground-water flow to lakes using computer models - A case study of Snake Lake, Wisconsin: N-C Section CSA, Abstracts with Programs, v. 11, no. 5, March, 1979, p. 236.

JOEL R. KUSHINS

hazardous waste management
underground storage tank
management
environmental property
evaluations
water resources

EDUCATION

California State University, Sacramento: M.S., Civil/Sanitary Engineering, 1976
University of California, Davis: B.S., Civil Engineering, 1971

REGISTRATION

Civil Engineer: California, Registration No., C29367

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Project Engineer, 1986-date
Computer Engineering Design, Inc., San Jose, Project Engineer, 1982-1985
Thermal Dynamics, Crockett, California, Civil Engineer/Sales Representative, 1980-1982
Kennedy/Jenks Engineers, San Francisco, Sanitary Engineer, 1980
Parsons Brinckerhoff Quade & Douglas, San Francisco, Senior Sanitary Engineer,
1979-1980
State Department of Health Services, Berkeley, California, Assistant Waste Management
Engineer, 1977-1979
Development and Resources Corporation, Sacramento, Associate Engineer, 1973-1977

REPRESENTATIVE EXPERIENCE

Mr. Kushins is a Project Engineer with more than 16 years of professional experience. This experience includes the management of engineering projects from initial field investigation to final design and supervision of contractor installations. Mr. Kushins' responsibility at Woodward-Clyde Consultants is in the area of hazardous waste management.

Representative professional experience includes:

- RI/FS Manager for a US Air Force Installation Restoration Program (Remedial Investigation/Feasibility Study). As RI/FS Manager, Mr. Kushins is responsible for the technical activities on the project. He is responsible for generating work plans, assisting Task Leaders in setting goals and milestones, and directing work within the tasks. He is also responsible for the review and modification of the technical requirements and specifications for subcontract services.
- Project Manager for an environmental site assessment on a 10-acre industrial parcel for The Home Depot. As Project Manager, Mr. Kushins coordinates all site history reviews and field work activities to assess whether levels of hazardous substances exist in the soil and groundwater underlying the site.
- Project Manager for The Clorox Company's underground storage tank management program. As Project Manager, Mr. Kushins coordinates all site-specific underground tank investigations, tank closures, design and installation of compliance monitoring systems, and liaison between the client and regulatory agencies.

JOEL R. KUSHINS

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- REM II (Superfund) Site Manager for an uncontrolled hazardous waste site listed on the Environmental Protection Agency's (EPA) National Priority List. As Site Manager, Mr. Kushins was responsible for leading a multidisciplinary professional team that provided technical oversight services to EPA. Technical oversight services included support to EPA through review of reports and Remedial Investigation/Feasibility Study activities conducted by the Potentially Responsible Party.
- Project Engineer for hazardous waste management projects related to the computer industry, including industrial waste collection systems, underground acid waste storage vaults, process gas handling, and seismic design for equipment and tanks containing hazardous materials.
- Senior Sanitary Engineer to the Southwest Ocean Outfall Project for the City and County of San Francisco, providing design review for the headworks and offshore structures and coordinating the environmental monitoring for the predischarge program, plume modeling, and bacterial reduction studies.
- Sanitary Engineer for the San Leandro Bay Environmental Study for the San Francisco Corps of Engineers, with responsibility for writing the water quality analysis report.
- Participated with a team of inspectors to monitor dredging in San Francisco Bay for the Corps of Engineers Industry Capability Program. Utilized a computer and plotter to verify the ship's course, capacity, speed, range, and distance for each load of material dredged and disposed.
- Assistant Waste Management Engineer responsible for advising local health and vector control agencies in a 16 county coastal region on vector prevention aspects of domestic, agricultural, and industrial wastes. Reviewed and commented on environmental impact reports, Corps of Engineers, and Bay Conservation and Development Commission permits for vector prevention standards and regulations.
- Reviewed applications for water supply utilities for loans under the California Safe Drinking Water Bond Act of 1976. Consulted with purveyors and coordinated the environmental documentation for new construction or rehabilitation of existing domestic water systems and processed final water permits for community systems.
- Participated with a team of engineers on federal flood control and water resource projects. Researched, processed, and interpreted data for hydrologic computer models for flood insurance studies.
- Consulted with general contractors on solar systems and designed roof connections for solar panels and storage tank braces to withstand wind and seismic loads.

AFFILIATIONS

American Society of Civil Engineers

ROBIN K. SPENCER

environmental engineering
hazardous materials management
project management

EDUCATION

University of California, Berkeley: B.A., Geography, 1980

University of California, Davis: Certificate, Hazardous Materials Management, 1987

Additional Courses and Workshops:

Chemistry of Hazardous Materials/Hazardous Wastes
Geology
Business Administration
Technical Writing
Certified Hazardous Materials Manager Review Course
Supervisor's Health and Safety Certification
Red Cross Standard First Aid and CPR
Level C Health and Safety Certification
NAUI-certified SCUBA diver

REGISTRATION

Certified Hazardous Materials Manager, 1989 (#1971)

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Senior Staff Scientist, 1985-date

University of California, Lawrence Berkeley Laboratory, Research Associate, 1979-1985

REPRESENTATIVE EXPERIENCE

Ms. Spencer's primary role at Woodward-Clyde has been administration of the EPA REM II Superfund contract, the third largest contract in Woodward-Clyde's history. For 4 years she served in a variety of capacities for more than eight Superfund sites, several of which had a budget of more than \$1 million each.

Ms. Spencer has worked primarily on three large projects:

- Pentachlorophenol, formaldehyde, and heavy metals contamination of soil and groundwater at a wood treatment plant Superfund site in Oroville, California. Remedial Investigation/Feasibility Study phase, 1985-1989. Budget: \$2.6 million.
- Asbestos mine and mill tailings Superfund site in Coalinga, California. Remedial Investigation/Feasibility Study phase, 1986-1988. Budget: \$2.3 million.
- Volatile organic compound contamination of soil and groundwater at a Superfund site in Tacoma, Washington. Remedial Design phase, 1985-1987. Budget: \$1.1 million.

Responsibilities included:

- Project Management: Acted as site manager or assistant site manager for four sites. Responsibilities included analyzing staffing and budget requirements,

ROBIN K. SPENCER

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producing work assignment amendments, organizing client/staff meetings, and reviewing regulatory requirements.

- Field Management: On-site supervisor for well installation; task leader for sampling, excavation, and residuals disposal; Site Safety Officer; Quality Assurance Officer (Tacoma, Washington; Oroville and Coalinga, California).
- Project Planning: Authored work plans, sampling and analysis plans, site management plans, data management plans, and quality assurance project plans. Developed project budgets. Reviewed EPA Region IX sampling and analysis plans.
- Data Assessment: Co-authored Remedial Investigation reports, field data reports and a Feasibility Study report. Feasibility Study task leader.
- Subcontract Administration/Equipment Procurement: Task leader for logistics on two major field investigations. Followed rigorous government contract procurement regulations for a 2-month (Coalinga, California) and a 5-month (Oroville, California) field investigation. Equipment and services for these two projects totaled about \$350,000. EPA commended the field operation at Oroville as "very well organized and prepared."
- Bid Specifications: Helped develop and write bid specifications for a \$1 million US Army Corps of Engineers remedial design (Tacoma, Washington). Authored bid specifications or request for proposals totaling more than \$250,000 for two projects (Oroville and Coalinga, California).
- Residuals Management: Task leader for removal of residuals from two sites to Class I landfills (Tacoma, Washington; and Oroville, California).
- Training: Trained WCC staff in EPA Contract Laboratory Program sample documentation procedures (Oroville and Coalinga, California). Organized three Red Cross First Aid and/or CPR classes for office. Chair of Earthquake Preparedness Committee.

Other Superfund projects with which Ms. Spencer has had similar involvement include:

Pentachlorophenol-contaminated wood treatment plant, Oroville, California
Pesticide-contaminated aquifer, Oahu, Hawaii
Heavy metals-contaminated valley, Kellogg, Idaho
Pesticide-contaminated aquifer, Crescent City, California
Responsible Party search, Sun Valley, California

Other WCC projects Ms. Spencer has participated in include:

- Site investigation and characterization of hazardous wastes at Air Force bases in Alaska. Sampling Task Leader, Health and Safety Officer and sampler for field efforts at four sites. Developed the generic Quality Assurance Project Plan used for several sites, co-authored work plans, decision documents, and the feasibility study report. Led site inspection tours for visiting Air Force/EPA/WCC delegations.

ROBIN K. SPENCER

page 3

- Environmental assessment/site audit and liability calculation for a large real estate acquisition. In a very short time frame, conducted site audits and title reviews for 18 sites in northern California.
- Seismic trench logging of a Bay Area fault in support of an Alquist-Priolo Special Studies Zone investigation for a hospital.
- Excavation supervision at a leaking underground storage tank site.
- Review of remedial investigation reports for chemical manufacturing plants in France and Italy. Reports produced and reviewed in the WCC Lausanne office.

Ms. Spencer's responsibilities at Lawrence Berkeley Laboratory included:

- Research in nuclear waste isolation, geothermal energy, and indoor air quality. Production of major scientific reports, including a review work on indoor air pollutants. Management of senior staff scientist's \$1.4 million research budget.

AFFILIATIONS

Society of Women Engineers
Academy of Hazardous Materials Managers

PUBLICATIONS/PRESENTATIONS

An introduction to Hazardous Materials/Hazardous Waste Management in the United States. Invited Speaker to Environmental Studies class, University of California at Berkeley, 1987.

Indoor air quality control techniques: A critical review (with W. Fisk, D.T. Grimsrud, F.J. Offerman, B. Pedersen, and R. Sextro). Lawrence Berkeley Laboratory, LBL-16493, 1984.

Listing of scientific data on the Baca Geothermal Field (with C.F. Tsang). Lawrence Berkeley Laboratory, LBL-17675, 1984.

Thermal impact of waste emplacement and surface cooling associated with geological disposal of nuclear waste (with J.S.Y. Wang, D.C. Mangold, and C.F. Tsang). Lawrence Berkeley Laboratory, NUREG/CR-2910, LBL-13341, 1981.

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